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AIRPORT VICINITY AIR POLLUTION MODEL ABBREVIATED VERSION USER'S--ETC(U)
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UNCLASSIFIED FAA-RD-78-111 NL

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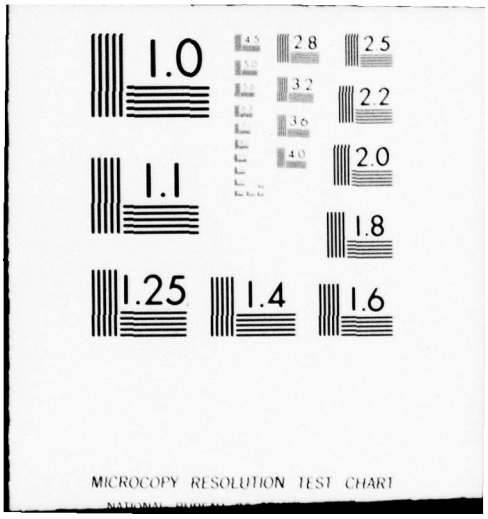
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(12) LEVEL II

Report No. FAA-RD-78-111

AIRPORT VICINITY AIR POLLUTION MODEL
ABBREVIATED VERSION
USER'S GUIDE

L.A. Conley D.M. Rote
Argonne National Laboratory
9700 South Cass Avenue
Argonne, Illinois 60439

September 1978
Final Report

Prepared for

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
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16. Abstract

This document describes the Airport Vicinity Air Pollution (AVAP) Model modified by the Energy and Environmental Systems Division of Argonne National Laboratory for the Federal Aviation Administration under Inter-Agency Agreement DOT-FA71WA1-223. This version of the model, Airport Vicinity Air Pollution Model Abbreviated Version, provides a "first-guess" estimate of an airport air pollution distribution based on more general input information than is described in Report No. FAA-RD-75-230, the model's primary form.

The user must establish a right-handed Cartesian coordinate system as a basis for describing an airport layout, then decide whether to use supplied default values applicable to the types of aircraft and airport facilities.

The estimate of pollutant concentrations are computed for selected individual receptor locations based on the dispersion of pollutant emissions from area and line type sources. Pollutant emission levels due to each member of a source type are tabulated. The results of a one one-hour modeling period of aircraft arrival-departure activities, airport ground-support services, and airport access vehicle roadways are tabulated for each receptor location and pollutant species.

The document presents a discussion of the theoretical considerations fundamental to the AVAP Model Abbreviated Version as well as program flow diagrams essential to understanding the theory. Required sequential card data input to the program is illustrated along with substitution options for program constants. Additionally, an example problem and a program listing are provided.

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METRIC CONVERSION FACTORS

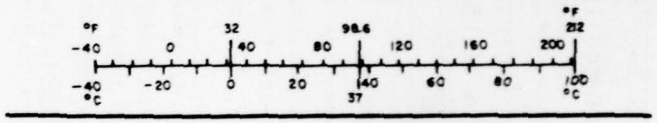
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in. = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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1 INTRODUCTION

The Airport Air Pollution Model, Abbreviated Version was developed at Argonne National Laboratory and executed on the IBM 360 Model 195 within a core region of 250K bytes while utilizing less than one minute of computer time. The FORTRAN coded program is yet another version of the Airport Air Pollution (AVAP) Model[1] modified to provide a first-guess estimate of an airport air pollution distribution.

This document discusses the theoretical considerations fundamental to the model, describes data input requirements for using the program, and illustrates the use of model by presenting an example problem. Therefore, users of the document should be technical personnel concerned with using the computer code for assessing air pollution impacts of commercial and general aviation airports. For more comprehensive studies, the model's primary form should be used.

In Section 2, the collection of formulas that form the basis of the computer program are presented. Detailed descriptions are to be found for area source and line source dispersion formulas. Although they are not used in this abbreviated version of AVAP, the Gaussian plume formula for a point source, the Carson-Moses plume rise formula, and the Briggs formula for estimating stack downwash effects are presented.

Section 3 provides guidelines for preparation of the input data. The formats and meanings of the input parameters are given along with their relative card position in the input sequence. Almost all of the input parameters that appear in this section havedefault values. Those that do not have default values are marked in Table 3.1. with the asterisk (*) character.

Section 4 provides a description and a table of the default values of the input parameters. All of the default values appear in the BLOCK DATA subprogram of the computer program; all or some of them can be changed by the appropriate data-card insertion.

Section 5 presents a complete example problem that details the resultant output from the model. Appendix A illustrates the conversion of pollutant concentration units and Appendix B gives the program flow diagrams of selected computational modules.

A complete listing of the FORTRAN coded program is found in Appendix C.

2 FORMULAS FOR CONCENTRATION CALCULATIONS

The formulas presented in this section will apply to both forms of the AVAP Model except that Point Source calculations are not required when using the abbreviated version. They form an outline of the most basic set of equations for concentration calculations but are not to be regarded as the complete set that covers all practical conditions of application. The user of the AVAP Model should consult the references quoted in this document for more complete descriptions.

2.1 DISPERSION COEFFICIENTS σ_y and σ_z

The dispersion coefficients σ_y and σ_z (miles) indicate the amount the pollutant plume has spread (dispersed) after leaving its source. To avoid unrealistic behavior of the σ functions at very high and very low wind speeds, the following formulas are used:

$$\sigma_y \equiv \sigma_y(T) = \text{Max}\left\{\sigma_{yT}(T), \sigma_{yx}(x)\right\}, \tag{1}$$

$$\text{and } \sigma_z \equiv \sigma_z(T) = \text{Max}\left\{\sigma_{zT}(T), \sigma_{zx}(x)\right\}, \tag{2}$$

where x is the downwind distance and T = x/u is the travel time. In Eqs. (1) and (2), $\sigma_{yT}(T)$ and $\sigma_{zT}(T)$ denote the travel-time-dependent dispersion coefficients. Curves of $\sigma_{yT}(T)$ for different Turner stability classes are displayed in Figure 2.1. Turner's original values for two-hour sampling time have been converted to one-hour sampling time by multiplication with the factor $(1/2)^{0.2}$ = 0.87. No conversion factor for sampling time is applied to the $\sigma_{zT}(T)$ values which are plotted in Figure 2.2. Figures 2.3 and 2.4 show the downwind-distance-dependent dispersion coefficients $\sigma_{yx}(x)$ and $\sigma_{zx}(x)$ derived from curves in Turner's Workbook for 10-minute sampling time, by multiplying the original $\sigma_{yx}(x)$ values by $(60/10)^{.2}$ and the original $\sigma_{zx}(x)$ values by $(20/10)^{.2}$. In doing so we have assumed that the vertical dispersion coefficient is insensitive to sampling times beyond 20 minutes, as suggested by Slade.

2.2 POINT SOURCE DISPERSION EQUATIONS

The short-term average concentration χ_p at the recptor point (x,y,z) due to a point source at

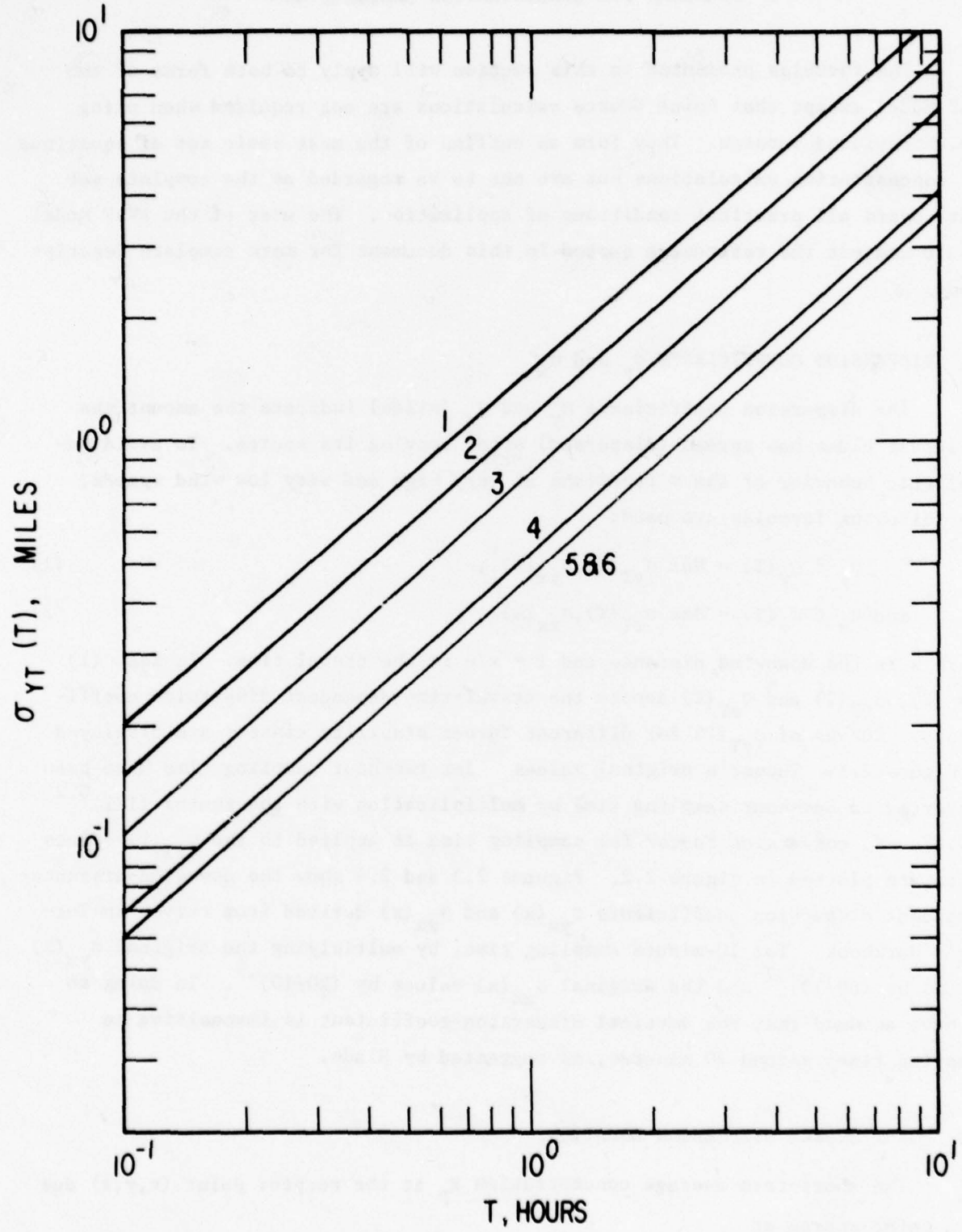

Figure 2.1. Time-Dependent Horizontal Dispersion Coefficients for 1-Hour Sampling Time.

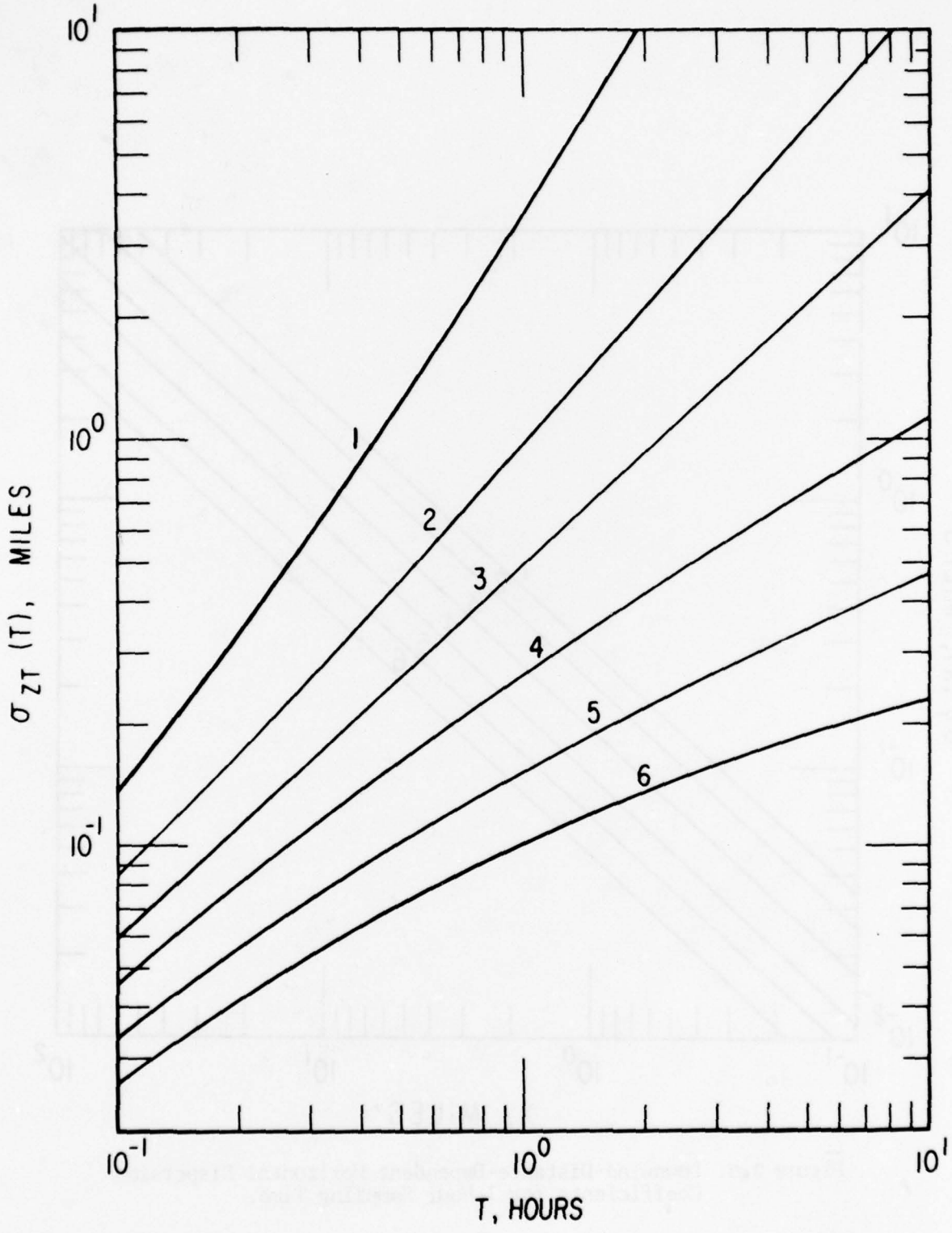

Figure 2.2. Time-Dependent Vertical Dispersion Coefficients for 1-Hour Sampling Time.

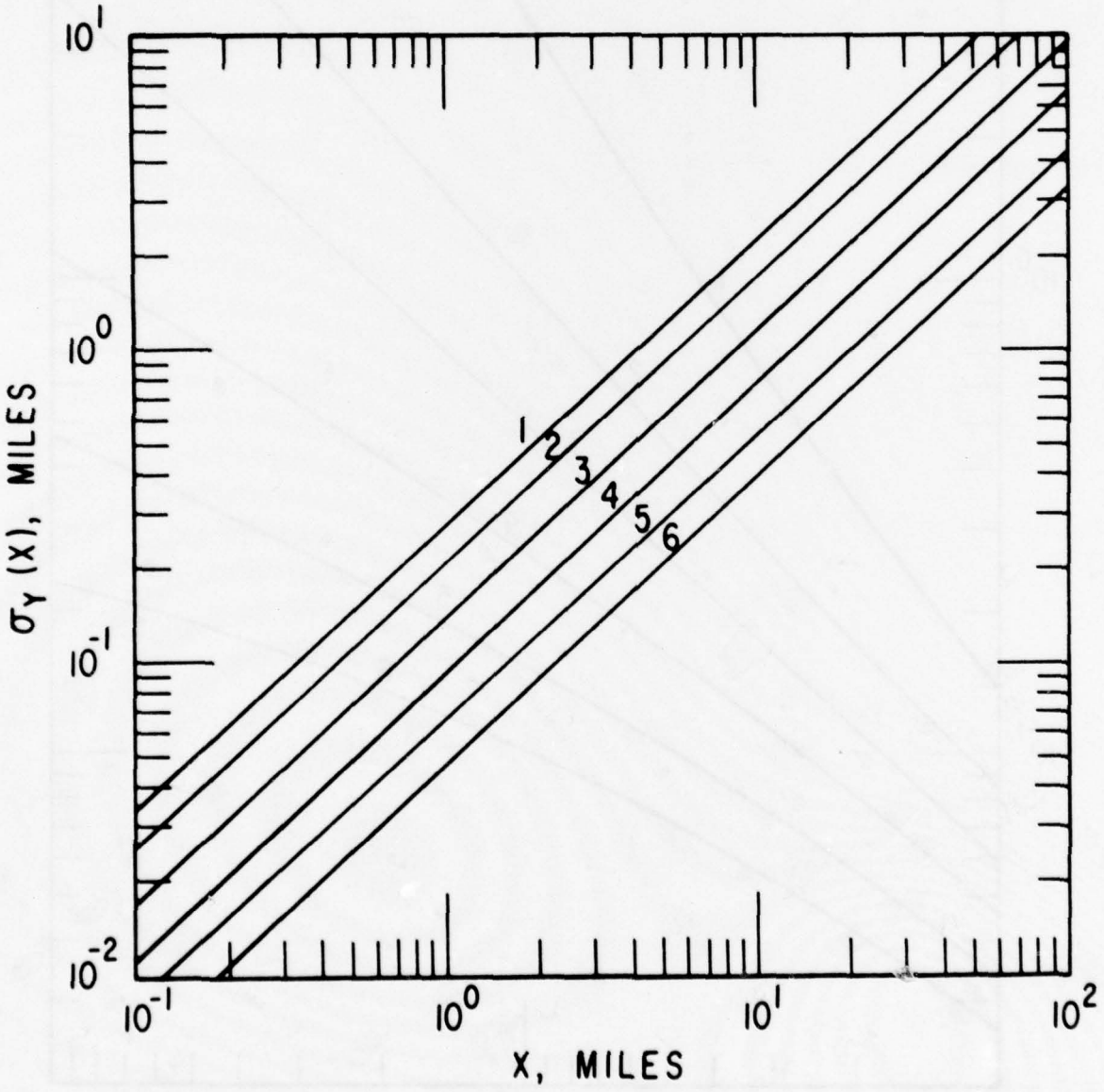

Figure 2.3. Downwind-Distance-Dependent Horizontal Dispersion Coefficients for 1-Hour Sampling Time.

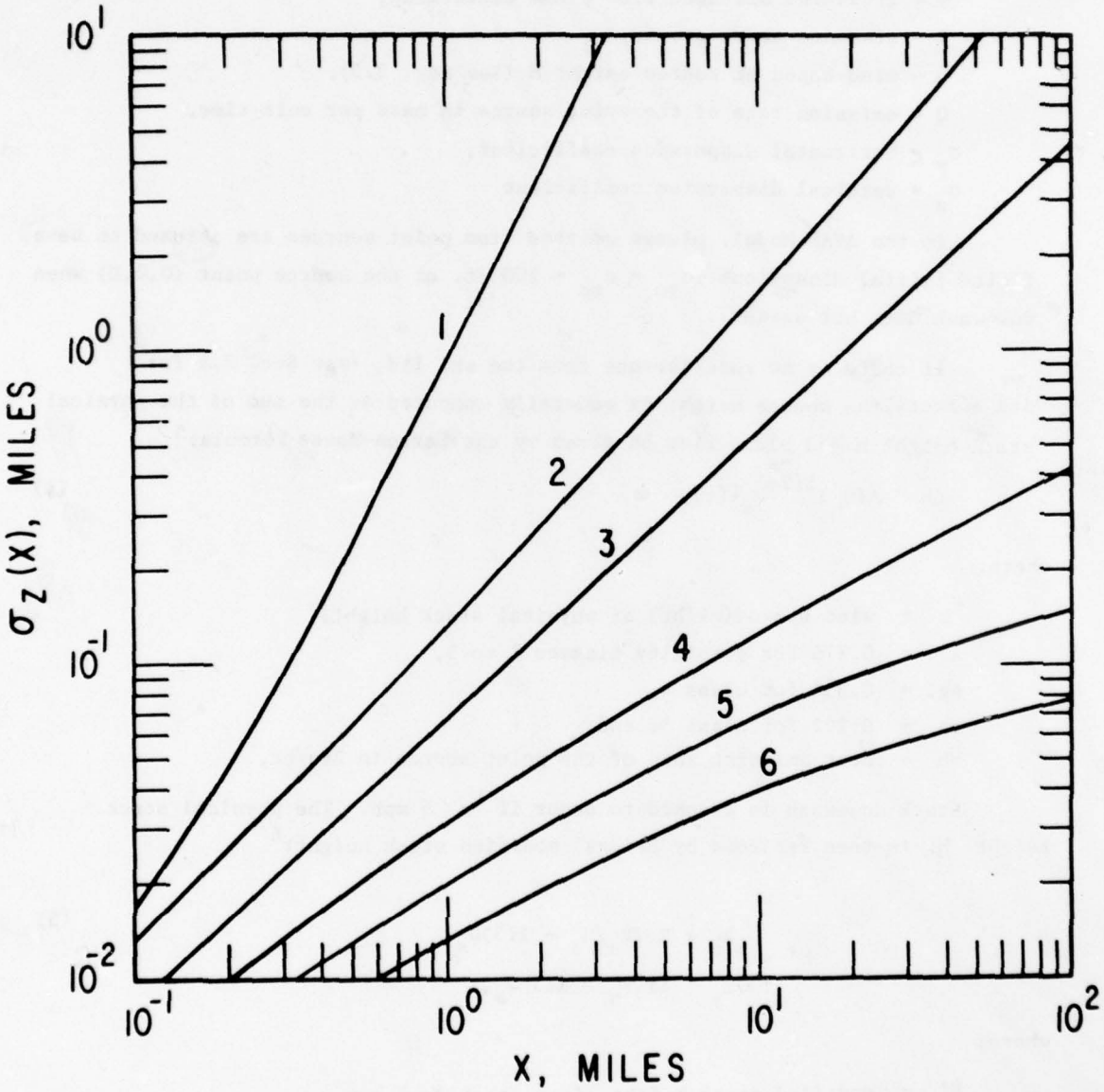

Figure 2.4. Downwind-Distance-Dependent Vertical Dispersion Coefficients for 1-Hour Sampling Time.

$$\chi_p = \frac{Q}{2\pi u \sigma_y \sigma_z} \exp\left[-\frac{1}{2}\left(\frac{Y}{\sigma_y}\right)^2\right] \cdot \left\{\exp\left[-\frac{1}{2}\left(\frac{Z-H}{\sigma_z}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{Z+H}{\sigma_z}\right)^2\right]\right\}. \quad (3)$$

where

y = crosswind distance from plume centerline,

Z = distance above ground,

u = wind speed at source height H (See Sec. 2.5).

Q = emission rate of the point source in mass per unit time,

σ_y = horizontal dispersion coefficient,

σ_z = vertical dispersion coefficient

In the AVAP Model, plumes emitted from point sources are assumed to have finite initial dimensions ($\sigma_{yo} = \sigma_{zo}$ = 100 ft. at the source point (0,0,H) when downwash does not appear).

If there is no interference from the ski lid, (see Sec. 2.6 for its effects) the source height is generally computed as the sum of the physical stack height h and plume rise Δh given by the Carson-Moses formula:[5]

$$\Delta h = A(Q_h)^{1/2}/U_s(ft), \quad (4)$$

where:

U_s = wind speed (mi/hr) at physical stack height,

A = 0.870 for stability classes 1 to 3,

sgl = 0.354 for class 4,

sp = 0.222 for class 5, and

Q_h = heat emission rate of the point source in Btu/hr.

Stack downwash is assumed to occur if $U_s > 6$ mph. The physical stack height h is then replaced by Briggs' modified stack height:[6]

$$h' = \begin{cases} Z_s + 2\,(V_s/U_s - 1.5)D_s, \\ Z_s \quad \text{if } V_s > 1.5\,U_s, \end{cases} \quad (5)$$

where:

h' = modified stack height after stack downwash,

V_s = stack effluent velocity, and

D_s = stack diameter.

Also, with stack downwash the initial plume dimensions are reassigned in the AVAP Model to simulate average city block size and building height (σ_{yo} = 250 ft; σ_{zo} = 40 ft).

For point sources with poor aerodynamic characteristics, such as vents or very short stacks on buildings, σ_{yo} is automatically assumed to be 250 ft and the building height h is used to compute σ_{zo} (σ_{zo} = h/1.2). If h is not supplied by the user the default value of 40 ft is used for σ_{zo}.

2.3 AREA SOURCE DISPERSION EQUATIONS

In the AVAP Model, two sets of dispersion equations are used for area sources. For convenience, area sources are classified as "near" sources and "far" sources depending on the relative location of the receptor and the area source.

First, the critical distance for mixing, x_c, is computed from the mixing height value L by the equation

$$\sigma_z(T = x_c/u) = 0.47\ L. \qquad (6)$$

If the critical distance measured upwind from the receptor is downwind of the downwind edge of the area source, the area source is defined as a "far" source. If the critical distance measured upwind from the receptor extends beyond the upwind edge of the source, the entire area source is treated as "near." There will be cases in which an area source is partitioned into a "near" and a "far" source relative to the receptor. The detailed logic for area source classification is presented in Appendix B on p. B-14.

The far area sources are treated conventionally, with the horizontal and vertical dispersions represented separately, each by an upwind virtual point source, so that at the downwind edge of the area source $\sigma_y = \sigma_{yo}$ and at the center $\sigma_z = \sigma_{zo}$. For an area source of side length d and vertical spread h, the initial Gaussian widths are given by σ_{yo} = d/2.4 and σ_{zo} = h/1.2.

For a complete discussion of the treatment of near area sources, the reader is referred to a separate report.[7] Briefly, it is to treat the area source in such a manner that the z component is represented by an upwind virtual line segment along the wind direction instead of a single point, with the simplifying assumption that σ_y is held constant over the area source. The z - component is analytically integrated over the line segment. Therefore, for receptor locations immediately downwind of the area source, the model is expected to give more realistic concentration profiles than the conventional area source model.

The short-term average concentration χ_a at the receptor point (x,y,z), due to an area source having its geometrical center at $(0,0,Z_a)$, is given by

$$\chi_a = \frac{Q_a.F}{2\pi\ \sigma_y d(1-b)} \exp\left[-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2\right] \cdot \left\{\exp\left[-\frac{1}{2}\left(\frac{Z - Z_a}{\sigma_z(T_2)}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{Z + Z_a}{\sigma_z(T_2)}\right)^2\right]\right., \quad (7)$$

where,

$$F = \frac{T_2}{\sigma_z(T_2)} - \frac{T_1}{\sigma_z(T_1)},$$

$$b = \frac{\ell n(\sigma_z(T_1)/\sigma_z(T_2))}{\ell_n(T_1/T_2)}$$

If b = 1, the factor F/(1-b) in Eq. 7 should be replaced by $T_1\ \ell n(T_2/T_1)/\sigma_z(T_1)$.

In the above equations, T_1 denotes the sum of T_z (pseudo travel time corresponding to σ_{zo}) and the travel time from the downwind edge of the area source to the receptor, and T_2 denotes the sum of T_z and the travel time from the upwind edge of the area source to the receptor. If the receptor is inside the area source, $T_1 = 0$. σ_y is computed with a travel time so that $\sigma_y = d/2.4$ at the downwind edge of the source, or if the receptor is inside the source it is assumed to be d/2.4 at the receptor.

2.4 FINITE LINE SOURCE DISPERSION EQUATIONS

The short-term average concentration χ_ℓ at the receptor point (x,y,z) due to a finite line source with inclination angle θ relative to ground, aximuthal angle ϕ relative to the wind vector and its end points at (0,0,0) and (Lcos θ cos ϕ, Lcos θ sin ϕ, Lsin θ) is given by

$$\chi_\ell = \frac{q_\ell}{2\pi\ u\bar{\sigma}_y\bar{\sigma}_z} .J, \quad (8)$$

with

$$J = (\sqrt{\pi}/2)\ .A.\sum_{i=1}^{2}\left\{\exp\left(B_i^2 - C_i^2\right)\left[\operatorname{erf}\left(B_i + L/A\right) - \operatorname{erf}\left(B_i\right)\right]\right\}$$

where

$$A = \sqrt{2}\ \bar{\sigma}_y\ \bar{\sigma}_z \left(\cos^2\theta \sin^2\phi\ \bar{\sigma}_z^2 + \sin^2\theta\ \bar{\sigma}_y^2\right)^{-1/2}$$

$$B_1 = -2\left(\bar{\sigma}_y\,\bar{\sigma}_z\right)^{-2}\ .A.\left[y\cos\theta\sin\phi\,\bar{\sigma}_z^{\,2} + (Z-H)\sin\theta\,\bar{\sigma}_y^{\,2}\right],$$

$$B_2 = -2\left(\bar{\sigma}_y\,\bar{\sigma}_z\right)^{-2}\ .A.\left[y\cos\theta\sin\phi\,\bar{\sigma}_z^{\,2} + (Z+H)\sin\theta\,\bar{\sigma}_y^{\,2}\right],$$

$$C_1 = \left[\frac{y^2}{2\bar{\sigma}_y^{\,2}} + \frac{(Z-H)^2}{2\bar{\sigma}_z^{\,2}}\right]^{1/2},$$

$$C_2 = \left[\frac{y^2}{2\bar{\sigma}_y^{\,2}} + \frac{(Z+H)^2}{2\bar{\sigma}_z^{\,2}}\right]^{1/2}.$$

The above formula is applicable only under certain conditions. For a complete discussion of the various criteria and the reasons behind them, the user is referred to Refs. 8 and 9. Normally, when the line source subtends a sufficiently large angle relative to the wind vector, for example, a uniform, horizontal line with ϕ greater than 45°, the formula is used without the segmentation scheme discussed in the references mentioned above. The dispersion coefficients $\bar{\sigma}_y$ and $\bar{\sigma}_z$ are evaluated with an effective downwind distance corresponding to a point on the line that is directly upwind of the receptor. When the relative angle is very small ($\leq 10^\circ$), the following approximation formula is used:

$$\chi_{\ell o} = \frac{1}{2\sqrt{2\pi}}\left(\frac{q_{\ell L}}{u}\right)\left(\bar{\sigma}_y\,\bar{\sigma}_z\right)^{-1}\ \exp\left[-\frac{y^2}{2\bar{\sigma}_y^{\,2}} - \frac{z^2}{2\bar{\sigma}_y^{\,2}}\right]. \qquad (9)$$

Again, for a long line source, the line is divided into shorter segments, and an effective $\bar{\sigma}_y$ and $\bar{\sigma}_z$ for each segment is evaluated for the downwind distance corresponding to the midpoint of the segment. For angles between 10° and 45° Eq. 8 is used with the segmentation scheme.

2.5 WIND PROFILE LAW

To convert the wind speed measured by anemometer at a local airport (typically 30 ft above ground) to that at the physical stack height h or to that at the effective source height H we use a power law relation of the form:

$$u(Z) = u(Z_o)\ (Z/Z_o)^p. \qquad (10)$$

The exponent P, as determined by DeMarrais[10], depends on the stability class and is given in Table 2.1.

Table 2.1 Exponents for Wind Profile

Stability Class		P
Unstable	($\leq$3)	0.2
Neutral	(4)	0.3
Stable	(5)	0.4
Very Stable	(6)	0.5

2.6 EFFECTS OF SKY LID

The lower surface of an elevated inversion layer is referred to as the sky lid, and as a rough approximation it is assumed to act as a perfect reflector. Thus the plume would generally be reflected repeatedly from two parallel surfaces, the ground and the sky lid. If the reflected plumes from a point source are represented by multiple image sources (see Fig. 2.5), then the net concentration at the receptor can be expressed in terms of a multiple image series:

$$\chi_p = \sum_{i=0}^{N} \chi_{pi}, \tag{11}$$

where χ_{po} = concentration due to original source, and

χ_{pi} = concentration due to i^{th} image source.

The above formula is used with N = 6 (i.e., three image sources below ground and three above the sky lid) when the downwind distance x of the receptor from the source is less than 2 x_c as calculated from Eq.(6). For downwind distances $x \geq 2\ x_c$, the net concentration is calculated with the assumption of full mixing in the mixing layer, and

$$\chi_p = \frac{Q}{\sqrt{2\pi}\ Lu\ \sigma_y} \exp\left[-1/2 \left(\frac{y}{\sigma_y} \right)^2 \right]. \tag{12}$$

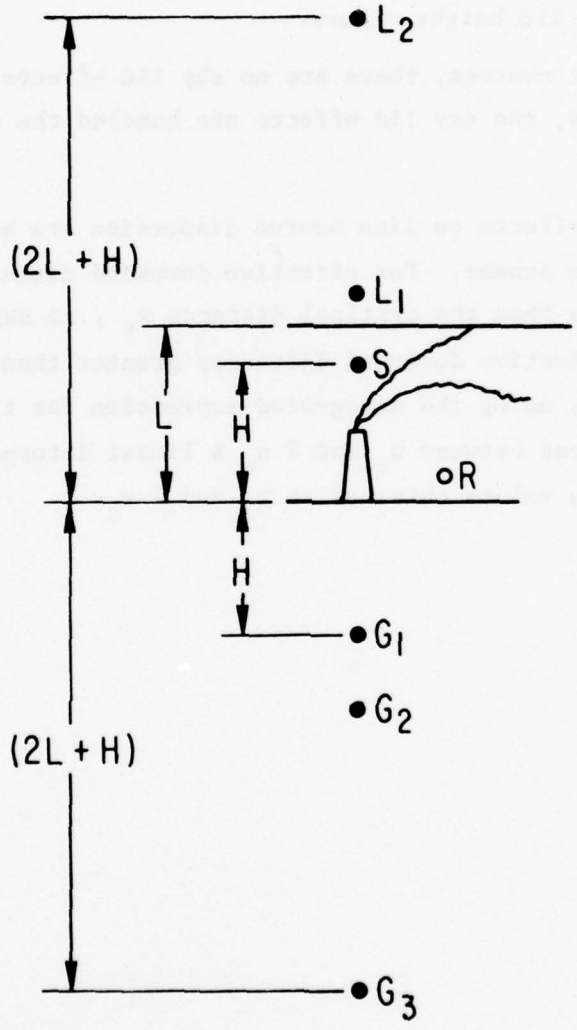

Figure 2.5. Multiple Reflections Between a Stable Layer and Ground Represented by Two Sets of Image Sources.

For some point sources (e.g., power plants with tall stacks), the calculated effective emission height H may be greater than the lid height, especially when the latter is small. These cases are not eliminated from consideration in the AVAP Model, but are simulated by using dispersion coefficients and plume rise for stably stratified air (stability class 5). Depending on the relative position of the lid, the physical stack height, and the computed effective stack height, the model will in some cases reassign the effective stack height or the lid height values.

For near area sources, there are no sky lid effects by definition. For far area sources, the sky lid effects are handled the same way as the point sources.

The sky lid effects on line source dispersion are handled by a simple linear interpolation scheme. For effective downwind distances (see Section 2.4 for definition) less than the critical distance x_c, no sky lid effects are assumed; and for effective downwind distances greater than 2 x_c, uniform vertical mixing is assumed by using the integrated expression for the Z-component. For downwind distances between x_c and 2 x_c a linear interpolation is applied to the concentration values obtained at x_c and 2 x_c.

3 DESCRIPTION OF INPUT

The first six (6) cards in the data deck (see Table 3.1) are the problem title and program parameter input cards required for every application of the model.

Card 1 is a single card of input having no computational value internal to the code. It may be punched or left blank. If punched, the same will appear as the first line of printed output.

Card 2 provides at least one identifying symbol chosen from the following set:

CO - Carbon Monoxide
THC - Total Hydrocarbons
NOX - Nitrogen Oxides
PART - Total Suspended Particulate

If the card is multiply punched, the program will calculate in turn the estimates of pollutant concentrations corresponding to the specified species.

Card 3 will provide the necessary meteorological data. Of the entries made on this card, the atmospheric stability index (JSTAB) should be deduced on the basis of wind speed, cloud cover, time of the day and other isolation parameters according to the scheme outlined by Turner[13]. Then lid height (NLID), if not obtainable by processing local sounding data, is estimated on the basis of JSTAB and the monthly average afternoon maximum mixing depths (meters above surface) tabulated by Holzworth[11]. The twelve (12) average values that are directly coded into the program (FUNCTION HMIX) apply to the Washington, D.C., region and are ordered by month (NMONTH) as follows: 400, 570, 1000, 930, 1120, 1310, 1180, 990, 980, 570, 680, and 480 (meters).

Card 4 provides an accounting of the receptors (points at which the model must estimate the pollutant concentration), the aircraft and aircraft-engine types, and the airport-access vehicle roadways. The aircraft area source comprises four emission sources: (1) ground service vehicles, (2) auxiliary poweruunits, (3) aircraft taxi within the area, and (4) aircraft-engine idle within the area. Therefore, an entry should exclude the aircraft area source (NACA=0) whenever the effects of all the above emission sources are suppressed. The non-aircraft area source is assigned pollutant emission levels later in the input stream, but may be excluded by setting NANA to zero (0).

Card 5 provides the indicators for user selected input. All of the punched card columns require that all corresponding card numbers, punched with all associated data, appear in the appropriate order of the input stream. For example, columns 18 and 21 are punched in order to indicate that card number 10 and card number 11 will appear in the input stream (see Table 3.1). Both of these bears entries for the number of engines with which each aircraft type is equipped, and the second bears entries that indicate the engine types.

Card 6 provides the location of specific receptor points.

The remainder of the input data deck is described in a list form in order to identify clearly those cards that are required for every application of the model and those cards that are used to over-ride program default values.

Card 7 thru Card 11	Refer to default values on page 27.
Card 12	Refer to default values on page 28.
Card 13	Refer to default values on page 30.
Card 14	Airport runway coordinates are always present.
Card 15	Refer to default values on page 30.
Card 16 thru Card 18	Refer to default values on page 29.
Card 19	Refer to default values on page 30.
Card 20 and Card 21	Airport taxiway coordinates are always present.
Card 22	Refer to default values on page 30.
Card 23 and 24	Runway apron coordinates are always present.
Card 25 thru Card 27	Refer to default values on page 30.
Card 28	Is required for access vehicle roadway coordinates.
Card 29	Is required for airport terminal area coordinates.
Card 30 and Card 31	Refer to default values on page 30.
Card 32	Refer to default values on page 31.
Card 33	Refer to default values on page 29.
Card 34	Refer to default values on page 31.
Card 35 and Card 36	Refer to default values on page 29.
Card 37	Is required for airport non-aircraft area coordinates.
Card 38	Is required for airport non-aircraft area pollutant emission level.

Note that, for the hour of interest, the user specifies the number of arriving aircraft of each type in Card 7. The number of aircraft departing during that same hour is assumed equal to the number of arrivals.

Table 3.1. Card Input Sequence

Card Type	Columns	Format	Comment
1 (1 card)*			
TITLE	1-80	(20A4)	Title card may be punched or left blank.
2 (1 card)*			
CO	1-2	(A4)	Four fields having four columns each are provided
THC	5-7	(A4)	so that one or more pollutant species may be
NOx	9-11	(A4)	chosen for the model run.
PART	13-16	(A4)	
3 (1 card)*			
HTAERO	1-8	F8.0	Height (feet) at which wind speed and direction are measured.
WSP	9-16	F8.0	Wind speed (knots).
DIR	17-24	F8.0	Wind direction (degrees).
TEMP	25-32	F8.0	Ambient temperature (degrees F).
JSTAB	33-40	I8	Atmospheric stability index.
NLID	41-48	I8	Lid height (tens of feet).
MONTH	49-50	I2	Month of year (required whenever NLID=0).
NR	51-52	I2	Hour of day (required whenever NLID=0 and JSTAB=4).
4 (1 card)*		I5	The total number (≤20) of receptor locations at
NSR	16-20	I5	which the model must estimate pollutant levels
NACT	21-25	I5	The number (≤10) of different aircraft types (B727, TØ, etc.) using airport facilities.
NENT	26-30	I5	The number (≤5) of different aircraft engine types (JT8D,TPE331) with which the above aircraft are equipped.
NAVR	31-35	I5	The number (≤60) of motor vehicle roadways leading into the airport.
NACA	36-40	I5	1 if aircraft area source is included. 0 otherwise.
NANA	41-45	I5	1 if non-aircraft area source is included. 0 otherwise.
5 (1 card)+			**If a blank or zero appears in any column the default value is used.**
DFAULT = 1	9		Card 7 data -- user defined.
2	12		Card 8 data -- user defined.
3	15		Card 9 data -- user defined.
4	18		Card 10 data -- user defined.
5	21		Card 11 data -- user defined.
6	24		Card 12 data -- user defined.
7	27		Card 13 data -- user defined.
8	30		Card 15 data -- user defined.
9	33		Card 16 data -- user defined.
10	35-36		Card 17 data -- user defined.
11	38-39	I3	Card 18 data -- user defined.
12	41-42		Card 19 data -- user defined.
13	44-45		Card 22 data -- user defined.
14	47-48		Card 25 data -- user defined.
15	50-51		Card 26 data -- user defined.
16	53-54		Card 27 data -- user defined.

Table 3.1. Card Input Sequence (contd.)

Card Type	Columns	Format	Comment
17	56-57		Card 30 data -- user defined.
18	59-60		Card 31 data -- user defined.
19	62-63		Card 32 data -- user defined.
20	65-66		Card 33 data -- user defined.
21	68-69		Card 34 data -- user defined.
22	71-72		Card 35 data -- user defined.
23	74-75		Card 36 data -- user defined.
5 (NSR cards)*			
NRUSED	1-2	I2	Any reference number.
XRECP	3-10	F8.0	X coordinate of receptor (mi
YRECP	11-18	F8.0	Y coordinate of receptor (mi
ZRECP	17-26	F8.0	Height of receptor (ft
7 (1 card)			
NAC(K)	6-55	(5X, 10I5)	NACT entries of the number of arriving aircraft of each type K. (Number of departures assumed to be the same as the number of arrivals).
8 (1 card)			
FLNDG(K)	6-55	(5X, 10F5.0)	NACT entries of time (hours) in landing mode for aircraft type K.
9 (1 card)			
FTKOF(K)	6-55	(5X, 10F5.0)	NACT entries of time (hours) in take-off mode for aircraft type K.
0 (1 card)			
NGIN(K)	6-55	(5X,10I5)	NACT entries for the number of engines with which aircraft type K is equipped.
1 (1 card)			
INGN(K)	6-55	(5X,10I5)	NACT entries for the engine type with which aircraft type K is equipped.
2 (NENT x 4 cards)			
EMI (I,J,K)	16-55	(15X, 5F10.0)	For each of the above engine types, enter an emission rate (lbs/hr) for each pollutant K (specified on card type 2). Cards 1 thru 4 for each engine type throttle setting will correspond to taxi, idle, landing and take-off modes, respectively.
3 (1 card)			
DSRW	16-25	F10.0	Width (mi) of initial dispersion on runway.
HRW	26-35	F10.0	Height (mi) of initial dispersion on runway.

Table 3.1. Card Input Sequence (contd.)

Card Type	Columns	Format	Comment
17	56-57		Card 30 data -- user defined.
18	59-60		Card 31 data -- user defined.
19	62-63		Card 32 data -- user defined.
20	65-66		Card 33 data -- user defined.
21	68-69		Card 34 data -- user defined.
22	71-72		Card 35 data -- user defined.
23	74-75		Card 36 data -- user defined.
6 (NSR cards)*			
NRUSED	1-2	I2	Any reference number.
XRECP	3-10	F8.0	X coordinate of receptor (mi
YRECP	11-18	F8.0	Y coordinate of receptor (mi
ZRECP	17-26	F8.0	Height of receptor (ft
7 (1 card)			
NAC(K)	6-55	(5X, 10I5)	NACT entries of the number of arriving aircraft of each type K. (Number of departures assumed to be the same as the number of arrivals).
8 (1 card)			
FLNDG(K)	6-55	(5X, 10F5.0)	NACT entries of time (hours) in landing mode for aircraft type K.
9 (1 card)			
FTKOF(K)	6-55	(5X, 10F5.0)	NACT entries of time (hours) in take-off mode for aircraft type K.
10 (1 card)			
NGIN(K)	6-55	(5X,10I5)	NACT entries for the number of engines with which aircraft type K is equipped.
11 (1 card)			
INGN(K)	6-55	(5X,10I5)	NACT entries for the engine type with which aircraft type K is equipped.
12 (NENT x 4 cards)			
EMI (I,J,K)	16-55	(15X, 5F10.0)	For each of the above engine types, enter an emission rate (lbs/hr) for each pollutant K (specified on card type 2). Cards 1 thru 4 for each engine type throttle setting will correspond to taxi, idle, landing and take-off modes, respectively.
13 (1 card)			
DSRW	16-25	F10.0	Width (mi) of initial dispersion on runway.
HRW	26-35	F10.0	Height (mi) of initial dispersion on runway.

Table 3.1. Card Input Sequence (contd.)

Card Type	Columns	Format	Comment
14 (1 card)*			
X1	16-25	F10.0	X coordinate of runway (mi) (Aircraft touch-down end)
Y1	26-35	F10.0	Y coordinate of runway (mi) (Aircraft touch-down end)
Z1	36-45	F10.0	Z height (ft) of runway. (Aircraft touch-down end)
X2	46-55	F10.0	X2 coordinate of opposite end point (mi)
Y2	56-65	F10.0	Y2 coordinate of opposite end point (mi)
Z2	66-75	F10.0	Z2 height of opposite end point (ft)
15 (1 card)			
VA1	16-25	F10.0	Initial velocity of arriving aircraft (mi/hr)
VA2	26-35	F10.0	Final velocity of arriving aircraft (mi/hr)
VD1	36-45	F10.0	Initial velocity of departing aircraft (mi/hr)
VD2	46-55	F10.0	Final velocity of departing aircraft (mi/hr)
TIME	56-65	F10.0	Aircraft take-off roll-time (hrs)
TAIL	66-75	F10.0	Exhaust tail length (mi)
16 (1 card)			
FTAXI(K)	6-55	(5X, 10F5.0)	NACT entries of aircraft taxi speed (mi/hr) while in the gate area for each aircraft type K.
17 (1 card)			
FTXII(K)	6-55	(5X, 10F5.0)	NACT entries of aircraft inbound taxi speed (mi/hr)
18 (1 card)			
FTXIO(K)	6-55	(5X, 10F5.0)	NACT entries of aircraft outbound taxi speed (mi/hr)
19 (1 card)			
DSTW	16-25	F10.1	Width (mi) of initial dispersion on taxiway.
HTW	26-35	F10.1	Height (mi) of initial dispersion on taxiway.
20 (1 card)*			
X1	16-25	F10.0	X coordinate of inbound taxiway (mi)
Y1	26-35		Y coordinate of inbound taxiway (mi)
Z1	36-45		Z height of inbound taxiway (ft)
X2	46-55		X2 coordinate of inbound taxiway (mi) (Airport terminal end)
Y2	56-65		Y2 coordinate of inbound taxiway (mi) (Airport terminal end)
Z2	66-75		Z2 height of inbound taxiway (ft) (Airport terminal end)

Table 3.1. Card Input Sequence, (contd.)

Card Type	Columns	Format	Comment
21 (1 card)*			
X1	16-25	F10.0	X coordinate of outbound taxiway (mi)
Y1	26-35	F10.0	Y coordinate of outbound taxiway (mi)
Z1	36-45	F10.0	Z height of outbound taxiway (ft)
X2	46-55	F10.0	X2 coordinate of outbound taxiway (mi) (apron end)
Y2	56-65	F10.0	Y2 coordinate of outbound taxiway (mi) (apron end)
Z2	66-75	F10.0	Z2 height of outbound taxiway (ft) (apron end)
22 (1 card)			
DSRA	16-25	F10.0	Width (mi) of initial dispersion on apron.
HRA	26-35	F10.0	Height (mi) of initial dispersion on apron.
23 (1 card)*			
X1	16-25	F10.0	X coordinate of inbound apron (mi)
Y1	26-35	F10.0	Y coordinate of inbound apron (mi)
Z1	36-45	F10.0	Z height of inbound apron (ft)
X2	46-55	F10.0	X2 coordinate of inbound apron (mi) (from here we start the inbound taxiway)
Y2			Y2 coordinate of inbound apron (mi) (from here we start the inbound taxiway)
Z2			Z2 height of inbound taxiway (ft)
24 (1 card)*			
X1	16-25	F10.0	X coordinate of outbound apron (mi)
Y1	26-35	F10.0	Y coordinate of outbound apron (mi)
Z1	36-45	F10.0	Z height of outbound apron (ft)
X2	46-55	F10.0	X2 coordinate of outbound apron (mi)
Y2	56-65	F10.0	Y2 coordinate of outbound apron (mi)
Z2	66-75	F10.0	Z2 height of outbound apron (ft)
25 (1 card) Omit if NAVR = 0.			
EFUH(J)	16-65	(15X, 5F10.0)	For each of the pollutants specified on card type 2, enter the urban automobile emission factor (gm/km) based on 25 mi/hr traffic speed.
26 (1 card) Omit if NAVR =0.			
EFUL(J)	16-65	(15X, 5F10.0)	For each of the pollutants specified on card type 2, enter the urban automobile emission factor (gm/km) based on 10 mi/hr traffic speed.
27 (1 card) Omit if NAVR = 0.			
DSAR	16-25	F10.0	Width (mi) of initial dispersion on access roadways.
HAR	26-35	F10.0	Height (mi) of initial dispersion on access roadways.

Also, with stack downwash the initial plume dimensions are reassigned in the AVAP Model to simulate average city block size and building height (o_{yo} = 250 ft; o_{zo} = 40 ft).

Table 3.1. Card Input Sequence (contd.)

Card Type	Columns	Format	Comment
28 (NAVR cards)*			Access vehicle roadways:
X1	11-20	F10.0	X coordinate of first end point (mi)
Y1	21-30	F10.0	Y coordinate of first end point (mi)
Z1	31-40	F10.0	Z coordinate of first end point (ft)
X2	41-50	F10.0	X coordinate of second end point (mi)
Y2	51-60	F10.0	Y coordinate of second end point (mi)
Z2	61-70	F10.0	Z coordinate of second end point (ft)
VNOON	71-78	F8.0	Average traffic volume
IFS	79-80	I2	Roadway classification: 1=congested, 0=non-congested
29 (1 card)*	Omit if NACA = 0.		
XS	16-25	F10.0	X coordinate of terminal area center (mi)
YS	26-35	F10.0	Y coordinate of terminal area center (mi)
STKH	36-45	F10.0	Height of terminal (ft)
WIT	46-55	F10.0	Side length of terminal (mi)
30 (1 card)	Omit if NACA = 0.		Pollutant emission rate of diesel engine powered service vehicles.
EFD(1)	16-25	F10.0	CO (gm/gal)
EFD(2)	26-35	F10.0	HC (gm/gal)
EFD(3)	36-45	F10.0	NOx (gm/gal)
EFD(4)	46-55	F10.0	PART (gm/gal)
EFD(5)	56-65	F10.0	SOx (gm/gal)
31 (1 card)	Omit if NACA = 0.		Pollutant emission rate of gasoline engine powered service vehicles.
EFG(1)	16-25	F10.0	CO (gm/mi)
EFG(2)	26-35	F10.0	HC (gm/mi)
EFG(3)	36-45	F10.0	NOx (gm/mi)
EFG(4)	46-55	F10.0	PART (gm/mi)
EFG(5)	56-65	F10.0	SOx (gm/mi)
32 (14 cards)	Omit if NACA = 0.		
SRVTIM(1,K)	6-55		NACT entries of service vehicle operation time (min) during the aircraft service operation in the terminal area. See Page 31 for a list of 14 modeled service vehicles.
33 (1 card)	Omit if NACA = 0.		
KAPU(K)	6-55	(5X, 10I5)	NACT entries denoting 1=the use of an auxiliary power unit: 0=no auxiliary power unit used for aircraft type K.
34 (1 card)	Omit if NACA = 0.		
APU(J)	16-65	(15X, 5F10.0)	For each of the pollutants specified on card type 2, enter the emission factors (lb/hr) for auxiliary power units.

expected to give more realistic concentration profiles than the conventional area source model.

Table 3.1. Card Input Sequence (contd.)

Card Type	Columns	Format	Comment
35 (1 card)	Omit if NACA = 0.		
FIDLE(K)	6-55	(5X, 10F5.0)	NACT entries of time (hr) for aircraft K engine idle.
36 (1 card)	Omit if NACA = 0.		
TGND(K)	6-55	(5X, 10F5.0)	NACT entries of time (min) for aircraft K gate occupancy.
37 (1 card)*	Omit if NANA = 0.		
XS	16-25	F10.0	X coordinate of non-aircraft area source center (mi)
YS	26-35	F10.0	Y coordinate of non-aircraft area source center (mi)
STKH	36-45	F10.0	Height of non-aircraft area source (ft)
WIT	46-55	F10.0	Side length of non-aircraft area source (mi)
38 (1 card)*	Omit if NANA = 0.		
EMIT(J)	16-65	(15X, 5F10.0)	For each of the pollutants specified on card type 2, enter the non-aircraft area source emission rate (lbs/hr)

*Default values for these data are not available.

+See Table 4.1, Program Default Values by Card Input Sequence Number.

4 DESCRIPTION OF DEFAULT DATA

This section describes for the user what is required as input data should the option to over-ride program constants be exericsed. Also, it lists the values of program constants (Table 4.1) as they appear in the BLOCK DATA subprogram of the computer code. All or some of the values will change whenever the appropriate card is inserted into the input stream.

The computer program is designed to model activity of ten (10) different aircraft types. These are listed in the first column of Table 4.1 (page 27) and may be replaced with types having identical, or nearly identical operational parameters, engine configurations, and ground service requirements. ments.

Operational parameters include time period values during which the aircraft-engine throttle setting is adjusted to one of the following operational modes:

1 Landing - Aircraft touch-down to beginning of taxi on the inbound apron.

2 Take-off - After alignment of aircraft with runway to liftoff.

3 Idle - Arriving aircraft awaiting gate position.

These operating times are shown in Table 4.1, page 27, columns 3 and 4, and page 29, column 6, respectively. Other operational parameters presented on page 29, columns 2, 3 and 4 consider the speed of aircraft while they are in the gate area, on the inbound taxiway and on the outbound taxiway, respectively. Those that detail the average performance characteristics of all aircraft types during flight modes of operation are shown on page 30 (Card 15).

Engine configuration and their emission characteristics are assigned integer values to denote for each aircraft type, and each engine type the number of engines per aircraft and their pollutant emission rates during 4 modes of operation (Taxi, Idle, Landing and Take-off). These values are shown in Table 4.1, page 27, columns 5 and 6 respectively, with corresponding pollutant emission rate shown on page 28.

The ground serivce requirements of each aircraft type are fulfilled using fourteen (14) different pieces of motorized equipment (page 31, Card 32), all of which operate within the gate area to load and unload cargo and otherwise prepare the airplane for its next departure. It can be seen by the service times entered into the table that the equipment in use is

dependent upon the type of aircraft being serviced. The pollutant emission rates (page 30, Cards 30, 31) are presented for both diesel and gasoline engine powered equipment. Note that an auxiliary power unit will provide electrical power, whenever used (Page 29, Column 5), for the entire gate time (Page 29, Column 7) of the aircraft. Its emissions rates are shown on Page 31, Card 34.

Table 4.1. Program Default Values by Card Input Sequence

Aircraft Type	Card 7 Hourly Arrivals	Card 8 Time (hr) Landing	Card 9 Time (hr) Take-off	Card 10 Number of Engines	Card 11 Engine Type
1 (Boeing 727)	10	0.0153	0.0111	3	1 (JT8D)
2 (Douglas DC9)	10	0.0153	0.0111	2	1 (JT8D)
3 (Boeing 737)	10	0.0153	0.0111	2	1 (JT8D)
4 (Convair 580)	10	0.0153	0.0111	2	3 (A-501-D13)
5 (BAC 111)	10	0.0153	0.0111	2	4 (SPEY-511)
6 (NAMC YS11)	10	0.0153	0.0111	2	3 (A-501-D13)
7 (Beech 99)	10	0.0110	0.0111	2	2 (TPE 331)
8 (Fairchild FH-227)	10	0.0153	0.0111	2	3 (A-501-D13)
9 (Twin Otter)	10	0.0110	0.0111	2	2 (TPE 331)
10 (Piston Engine)	10	0.0110	0.0111	2	5 (320)

Table 4.1. Program Default Values by Card Input Sequence (Contd)

Card 12 Pollutant Emission Rate for Each Engine Type During 4 Modes of Operation (lbs/hr)

		CO	HC	NO_x	PART	SO_2
Engine Type 1 (JT8D)	Taxi	37.0	9.0	2.0	0.5	0.9
	Idle	37.0	9.0	2.0	0.5	0.9
	Landing	25.6	5.6	36.3	6.8	3.2
	Take-off	6.0	0.4	133.3	21.0	8.6
Engine Type 2 (TPE 331)	Taxi	3.53	0.88	0.96	0.10	0.5
	Idle	3.53	0.88	0.96	0.10	0.5
	Landing	2.58	0.24	1.69	0.38	0.9
	Take-off	0.39	0.05	3.64	0.62	1.9
Engine Type 3 (All. 501-D13)	Taxi	15.0	6.0	2.0	0.10	0.5
	Idle	15.0	6.0	2.0	0.10	0.5
	Landing	10.1	3.8	8.0	0.30	0.9
	Take-off	2.0	0.4	23.0	0.60	1.9
Engine Type 4 (Spey 511)	Taxi	60.0	66.0	1.0	0.04	0.6
	Idle	60.0	66.0	1.0	0.04	0.6
	Landing	45.6	40.3	42.1	0.30	2.2
	Take-off	14.0	0.0	153.0	0.80	6.2
Engine Type 5 (Ø-320)	Taxi	11.41	0.38	0.01	0.06	0.01
	Idle	11.41	0.38	0.01	0.06	0.01
	Landing	11.41	0.38	0.01	0.06	0.01
	Take-off	72.52	1.66	0.23	0.12	0.07

Table 4.1 (Cont'd)

Card 13 Initial dimensions of dispersion on runway.

Width = DSRW = 0.030 miles
Height = HRW = 0.002 miles

Card 15 Runway parameters for arrival and departure aircraft.

VA1 = Runway - arrival initial velocity = 145 (mi/hr)
VA2 = Runway - arrival final velocity = 25 (mi/hr)
VD1 = Runway - departure initial velocity = 0.0 (mi/hr)
VD2 = Runway - departure final velocity = 180 (mi/hr)
TIME = Take-off roll time = .0111 (hrs)
TAIL = Exhaust tail length = .8523 (mi)

Card 19 Initial dimensions of dispersion on taxiway.

Width = DSTW = 0.030 (mi)
Height = HTW = 0.002 (mi)

Card 22 Initial dimensions of dispersion on runway apron.

Width = DSRA = 0.095 (mi)
Height = HRA = 0.002 (mi)

Card 25 Urban automobile pollutant emission factors (gm/km) based on 25 (mi/hr) traffic speed.

CO = 32.36, HC = 4.75, NO_x = 3.46, PART = 0.19, SO_x = 0.11

Card 26 Urban automobile pollutant emission factors (gm/km) based on 10 (mi/hr) traffic speed.

CO = 70.18, HC = 8.62, NO_x = 2.86, PART = 0.19, SO_x = 0.11

Card 27 Initial dimensions of dispersion on access roadway.

Width = DSAR = 0.0095 (mi)
Height = HAR = 0.001 (mi)

Card 30 Pollutant emission factor for diesel engine powered service vehicles in (gm/gal).

CO = 126.6, HC = 21.9, NO_x = 185.82, PART = 5.9, SO_x = 0.0

Card 31 Pollutant emission factor for gasoline engine powered service vehicles in (gm/mi).

CO = 138.81, HC = 21.35, NO_x = 9.32, PART = 0.85, SO_x = 0.0

Table 4.1 (Cont'd)

Aircraft Type	Card 16 Speed (mi/hr) Gate area taxi	Card 17 Speed (mi/hr) Inbound taxi	Card 18 Speed (mi/hr) Outbound taxi	Card 33 APU use flags	Card 35 Time (hr) Engine idle	Card 36 Time (min) Gate occupancy
1 (Boeing 727)	10	15	12	1	.033	52.
2 (Douglas DC9)	10	15	12	1	.033	52.
3 (Boeing 737)	10	15	12	1	.033	52.
4 (Conviar 580)	10	15	12	1	.033	52.
5 (BAC 111)	10	15	12	0	.033	52.
6 (NAMCO YS 11)	10	15	12	0	.033	52.
7 (Beech 99)	10	15	12	0	.033	52.
8 (Fairchild FH 227)	10	15	12	0	.033	52.
9 (Twin Otter)	10	15	12	0	.033	52.
10 (Piston Engine)	10	15	12	0	.033	52.

Table 4.1 (Cont'd)

Card 34 Pollutant emission factors for auxiliary power units in (lbs/hr).

$CO = 2.82$, $HC = 0.11$, $NO_x = 1.24$, $PART = 0.0$, $SO_x = 0.0$

Card 32. Minutes of Service Vehicle Operation While Servicing Aircraft Type I

	Aircraft Type									
Vehicle Type	1* 727	2* DC9	3* 737	4* C5	5 BAC	6 YS	7 B9	8 FH	9 TO	10 GA
1 Tractor	66	48	85	55	50	50	0	0	0	0
2 Belt Loader	28	15	30	0	25	25	0	0	0	0
3 Container Loader	6	0	0	0	0	0	0	0	0	0
4 Cabin Service	12	0	15	0	0	0	0	0	0	0
5 Lavatory Truck	15	15	15	10	10	10	5	5	5	0
6 Water Truck	0	10	0	10	10	10	5	5	5	0
7 Food Truck	17	17	20	10	10	10	0	0	0	0
8 Fuel Truck	20	15	15	10	20	20	10	10	10	0
9 Tow Tractor	10	5	5	5	5	5	0	0	0	0
10 Conditioner	0	0	0	0	0	0	0	0	0	0
11 Airstart Transporting and Diesel Engines	0	0	0	0	0	0	0	0	0	0
12 Ground Power Transporting and Gasoline Engines	0	0	0	0	0	0	0	0	0	0
13 Ground Power Unit Diesel Engine	0	0	0	0	0	0	0	0	0	0
14 Transporter	3	0	0	0	0	0	0	0	0	0

*Also serviced by an Auxiliary Power Unit (APU)

5 EXAMPLE PROBLEM

5.1 INTRODUCTION

In order to clarify the procedure for using the AVAP Model Abbreviated Version, a "first-guess" estimate of pollutant concentration is presented for the example airport-layout shown in Figure 5.1 . It is instructive to state that the locations of line type sources (runway, taxiway, apron, access roadway) are specified by the coordinates at their edge (from end to end), but the locations of airport terminal and non-aircraft area sources are specified by the coordinates at their center. Since aircraft movement on the runway is almost always into the wind (given as 180 degrees) the pattern of runway-apron-taxiway usage emerges. The pattern, for the airport-layout shown, is clockwise starting from the northern most point of the runway (landing aircraft touch-down). The input coordinates must be ordered to preserve this pattern. Therefore, all aircraft prepared for departure are queued before take-off on Apron 2 (outbound).

In this example, of the ten different aircraft types for which the Abbreviated Version is internally coded, seven are considered. They are listed with their associated engine type as follows:

(Boeing 727 & 737, Douglas DC9) JT8D turbofan engine
(Beech 99) TPE 331 turboprop engine
(Convair 580, NAMC YS11) A11. 501-D13 turboprop engine
(Small Piston Engine aircraft) Ø320 small piston engine

5.2 STATEMENT OF THE PROBLEM

GIVEN: Two pollutant species: Carbon Monoxide and Oxides of Nitrogen

Height of aerovane	10 ft
Wind speed	13 knots
Wind direction	180 degrees
Ambient temperature	36 degrees F
Stability index	4
Lid height	0 (Uses coded table from Holzworth)

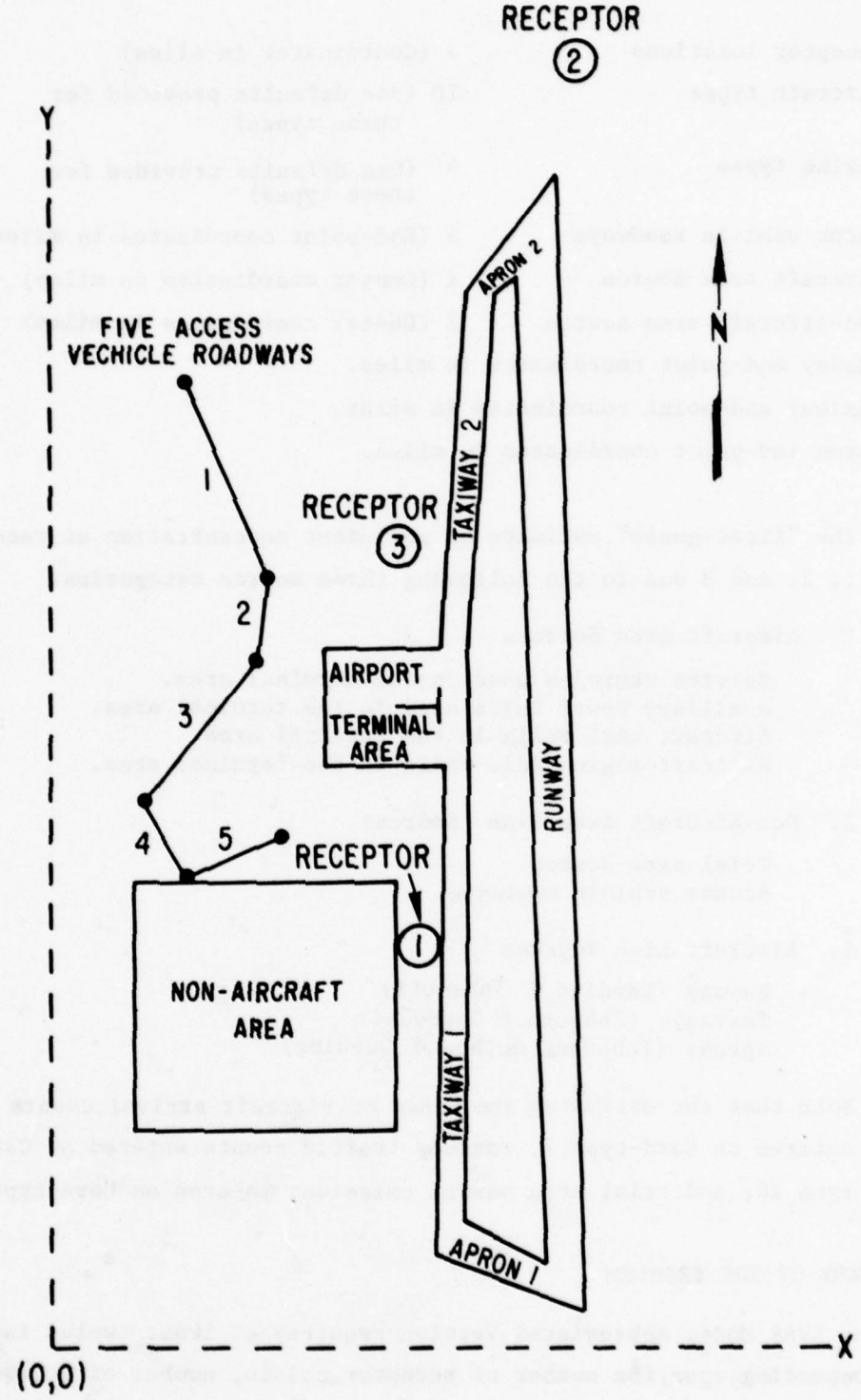

Figure 5.1 Example Airport-Layout

Receptor locations	3 (Coordinates in miles)
Aircraft types	10 (Use defaults provided for these types)
Engine types	4 (Use defaults provided for these types)
Motor vehicle roadways	5 (End-point coordinates in miles)
Aircraft area source	1 (Center coordinates in miles)
Non-aircraft area source	1 (Center coordinates in miles)

Runway end-point coordinates in miles.

Taxiway end-point coordinates in miles.

Apron end-point coordinates in miles.

FIND: The "first-guess" estimate of pollutant concentration at receptors 1, 2, and 3 due to the following three source categories:

1. Aircraft Area Sources

   Service vehicles used in the terminal area.
   Auxiliary Power Units used in the terminal area.
   Aircraft taxi while in the terminal area.
   Aircraft-engine idle while in the terminal area.

2. Non-Aircraft Area-Line Sources

   Trial area source
   Access vehicle roadways

3. Aircraft Line Sources

   Runway (Landing & Take-off)
   Taxiways (Inbound & Outbound)
   Aprons (Inbound, Outbound Queuing)

Note that the estimates are based on aircraft arrival counts entered on Card-type 7, roadway traffic counts entered on Card-type 28, and trial area source emissions entered on Card-type 38.

5.3 SUMMARY OF THE PROBLEM

The AVAP Model Abbreviated Version requires at least twelve input cards. Depending upon the number of receptor points, number of access vehicle roadways and choice of default values, there may be more. The format for each card is given in Table 3.1. Table 5.1 lists the input for the sample problem; Table 5.2 lists the results. Note that a descriptive list of program values starts the table of results. Also note

that a tabulation of pollutant emission levels for each area and line type source is provided. The micrograms-per-cubic-meter notation, as seen in the concentrations tabulation, is used for Total Suspended Particulates (PART) if it is one of the pollutants being modeled.

Table 5.1 Input for Example Problem

```
 SHORT MODEL TEST JAN. 1977    EXAMPLE 1
CO      NOX
      10.      13.      180.      36.        4          0 315        MET DATA
CONTROL CARD          3   10     4    5     1     1
CTAGET  1
  1  .440      .432    6.562
  2  .590     1.51     6.562
  3  .375      .925    6.562
A/C       7      8      2      1      0      2      1      0      0     11
RUNWAY COORD.          .524        1.338          10.          .616        .063          10.
TAXIWAY COORD 1        .473         .091          10.          .376        .724          10.
TAXIWAY COORD 2        .376         .801          10.          .438       1.240          10.
APRON COORD 1          .616         .063          10.          .473         .091         10.
APRON COORD 2          .524        1.338          10.          .438       1.240          10.
ROADWAY  1      .0730     1.0853      5.          .1938     1.0675      5.          500. 0
ROADWAY  2      .1938     1.0675      5.          .1781      .7353      5.          400. 0
ROADWAY  3      .1781      .7353      5.          .0406      .5343      5.          300. 0
ROADWAY  4      .0406      .5343      5.          .0938      .4376      5.          425. 0
ROADWAY  5      .094       .438       5.          .281       .528       5.          550. 0
A/C AREA               .395         .753          11.          .077
NON-A/C AREA           .168         .288          16.          .3
NON-A/C EMIS         793.8          0.0           0.0          0.0          0.0
```

Table 5.2 Results of Example Problem

```
SHORT NOTE TEST JAN. 1977     EXAMPLE 1
POLLUTANT CHOICE =          CO        NOX
AIRPORT PARAMETERS:
                        NUMBER OF RECEPTORS_____________________________    3
                        NUMBER OF RUNWAYS_______________________________    1
                        NUMBER OF TAXIWAYS______________________________    2
                        NUMBER OF APRONS________________________________    2
                        NUMBER OF TERMINAL AREAS________________________    1
                        NUMBER OF AIRCRAFT TYPES________________________   10
                        NUMBER OF AIRCRAFT ENGINE TYPES_________________    4
                        NUMBER OF SERVICE VEHICLE TYPES_________________   14
                        NUMBER OF ACCESS VEHICLE ROADWAYS_______________    5
                        NUMBER OF AIRPORT NON-AIRCRAFT AREA SOURCES______   1
   3 RECEPTOR COORDINATES (X,Y,Z):
      0.4440  0.4520  6.5620
      0.5900  1.5100  6.5620
      0.3750  0.7250  6.5620
IRU  1  2  3
 AERIVANE HEIGHT =  10.0 FT.   WIND SPEED = 14.95 MPH   WIND DIRECTION= 180. DEGREES
AMBIENT TEMPERATURE =30.0 F DEGREES  STABILITY CLASS INDEX =4  LID HEIGHT =3281.0 FT.
ARRIVAL ACTIVITY FOR AIRCRAFT TYPES 1 THROUGH 10     7  6  2  1  0  2  1  0  0 11
LANDING TIME      0.015300.015300.015300.015300.015300.015300.011000.015300.011000.011
TAKE-OFF TIME     0.011100.011100.011100.011100.011100.011100.011100.011100.011100.011
             1 37.00     2.00
             2 37.00     2.00
             3 25.60    16.30
             4  6.00   123.30
             1  3.53     0.96
             2  3.53     0.96
             3  2.58     1.69
             4  0.39     3.64
             1 15.00     2.00
             2 15.00     2.00
             3 10.10     8.00
             4  2.00    23.00
             1 60.00     1.00
             2 60.00     1.00
             3 45.60    42.10
             4 14.00   153.00
             1 11.41     0.01
             2 11.41     0.01
             3 11.41     0.01
             4 72.52     0.23
END-POINT COORDINATES OF RUNWAYS
      0.52400   1.53900  10.00000   0.61600   0.06300  10.00000
AIRAY PARAMETERS:
    145.00000  25.00000   0.0      180.00000   0.01110   0.08523
TAXI SPEED          10.0  10.0  10.0  10.0  10.0  10.0  10.0  10.0  10.0  10.
INBOUND SPEED       15.0  15.0  15.0  15.0  15.0  15.0  15.0  15.0  15.0  15.
OUTBOUND SPEED      12.0  12.0  12.0  12.0  12.0  12.0  12.0  12.0  12.0  12.
```

Table 5.2 Results of Example Problem (contd.)

```
END-POINT COORDINATES OF TAXIWAYS
      0.47300   0.09100  10.00000   0.37600   0.72400  10.00000
END-POINT COORDINATES OF TAXIWAYS
      0.37600   0.80100  10.00000   0.43800   1.24000  10.00000
HORIZONTAL AND VERTICAL SPREAD:
   RUNWAYS     0.01250   0.00167
   TAXIWAYS    0.01250   0.00167
   APRONS      0.09500   0.00200
END-POINT COORDINATES OF APRONS
      0.61000   0.06300   0.00189   0.47300   0.09100   0.00189
END-POINT COORDINATES OF APRONS
      0.52400   1.33800   0.00189   0.43800   1.24000   0.00189
   POLLUTANT EMISSION FACTORS-- 25MPH URBAN AUTOMOBILE TRAFFIC:
    32.56  3.46
   POLLUTANT EMISSION FACTORS-- 10 MPH URBAN AUTOMOBILE TRAFFIC:
    77.15  2.85
END-POINT COORDINATES, TRAFFIC INTENSITIES, AND INDICATORS OF ACCESS VEHICLE ROADWAYS
         0.07      1.09      5.00      0.19      1.07      5.00    500.00    0
         0.19      1.07      5.00      0.18      0.74      5.00    400.00    0
         0.18      0.74      5.00      0.04      0.53      5.00    300.00    0
         0.04      0.53      5.00      0.09      0.44      5.00    425.00    0
         0.11      0.44      5.00      0.28      0.53      5.00    550.00    0
   POLLUTANT EMISSION FACTORS(DIESEL ENGINE) GM/GAL
   CO =      126.00
   NOX =     135.00
   POLLUTANT EMISSION FACTORS(GASOLINE ENGINE) GM/MI
   CO =      138.81
   HC =        9.52
   AVERAGE VEHICLE OPERATION TIME(MIN.):
TAXIWAYS      60.0 45.0 65.0 55.0 50.0 50.0  0.0  0.0  0.0  0.0
RUNWAYS       25.0 15.0 30.0  0.0 25.0 25.0  0.0  0.0  0.0  0.0
APRONS         5.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0
GATE 1        12.0  0.0 15.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0
GATE 2        15.0 15.0 15.0 10.0 10.0 10.0  5.0  5.0  5.0  0.0
GATE 3         0.0 10.0  0.0 10.0 10.0 10.0  5.0  5.0  5.0  0.0
GATE 4        17.0 17.0 20.0 10.0 10.0 10.0  0.0  0.0  0.0  0.0
GATE 5        20.0 15.0 15.0 10.0 20.0 20.0 10.0 10.0 10.0  0.0
GATE 6        10.0  5.0  5.0  5.0  5.0  5.0  0.0  0.0  0.0  0.0
GATE 7         0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0
GATE 8         0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0
GATE 9         0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0
GATE 10        0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0
GATE 11        0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0
   0.033000.033000.033000.033000.033000.033000.033000.033000.033000.03300
   ((X,Y),DEF(MT,WIDTH)
    1.23600  16.03000   0.30000
```

Table 5.2 Results of Example Problem (contd.)

POLLUTANT EMISSION RATE (POUNDS)

	CO	NOX
AIRCRAFT LANDING	19.8	23.5
AIRCRAFT TAKE-OFF	20.6	62.3
INBOUND APRON	18.1	0.9
OUTBOUND QUEUING	198.8	10.3
INBOUND TAXIWAY	79.6	4.1
OUTBOUND TAXIWAY	68.9	3.6
SERVICE VEHICLE	265.0	8.8
AUX. POWER UNIT	44.0	19.3
TERM. AREA TAXI	14.4	0.7
TERM AREA ENG. IDLE	61.5	3.2
AIRCRAFT AREA	384.9	32.0
NON-AIRCRAFT AREA	793.8	0.0
ACCESS VEHICLE		
1	7.0	0.7
2	15.3	1.6
3	8.4	0.9
4	5.4	0.6
5	13.1	1.4

Table 5.2 Results of Example Problem (contd.)

POLLUTANT CONCENTRATIONS : M/CM=MICROGRAMS PER CUBIC METER

RECEPTOR 1

COORDINATES (0.444, 0.452)

	CO(PPM)	NOX(PPM)
AIRCRAFT AREA	0.0	0.0
NON-AIRCRAFT AREA-LINES	0.171	0.0
AIRCRAFT LINE	0.303	0.010
TOTAL	0.475	0.010

POLLUTANT CONCENTRATIONS : M/CM=MICROGRAMS PER CUBIC METER

RECEPTOR 2

COORDINATES (0.590, 1.510)

	CO(PPM)	NOX(PPM)
AIRCRAFT AREA	0.039	0.002
NON-AIRCRAFT AREA-LINES	0.030	0.000
AIRCRAFT LINE	0.075	0.043
TOTAL	0.144	0.045

POLLUTANT CONCENTRATIONS : M/CM=MICROGRAMS PER CUBIC METER

RECEPTOR 3

COORDINATES (0.375, 0.925)

	CO(PPM)	NOX(PPM)
AIRCRAFT AREA	1.413	0.072
NON-AIRCRAFT AREA-LINES	0.192	0.000
AIRCRAFT LINE	0.410	0.013
TOTAL	2.015	0.084

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5. J. E. Carson and H. Moses, "The Validity of Currently Popular Plume Rise Formulas," Proc. USAEC Meteorological Information Meeting, Held at Chalk River Nuclear Laboratories, September 11-14, 1967, AECL-2787, I-20 (1967).

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9. I. T. Wang and D. M. Rote, "A Finite Line Source Dispersion Model for Mobile Source Air Pollution." Journal of Air Pollution Control Association, 25, 730-733 (1975).

10. G. A. DeMarrais, "Wind-Speed Profile at Brookhaven National Laboratory", J. Meteorol., 16, 181-190 (1959).

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APPENDIX A

CONCENTRATION CONVERSIONS

Concentration ($\mu g/m^3$) = $1.22 \times 10^4 \frac{P}{T} \cdot MW \cdot$ concentration (ppm) where

P = pressure in atmospheres,

T = absolute temperature (°K)

MW = molecular weight

Example: NO_2

P = 1 atm

T = 77°F ≡ 25°C ≡ 273 + 25 = 298°K

MW = 14 + 32 = 46

Concentration ($\mu g/m^3$) = $1.22 \times 10^4 \times \frac{1}{298} \times 46 \times$ concentration (ppm)

= 1883 x concentration (ppm)

for T = 32°F,

Concentration ($\mu g/m^3$) = 2056 x concentration (ppm)

Note that for a pollutant class like THC or NO_x, it is customary to convert from ppm to $\mu g/m^3$ by representing the class in terms of a single pollutant such as CH_4 or NO_2. Consequently, under the same conditions as given above (T = 32°F),

THC Concentration ($\mu g/m^3$) (treated as CH_4) =

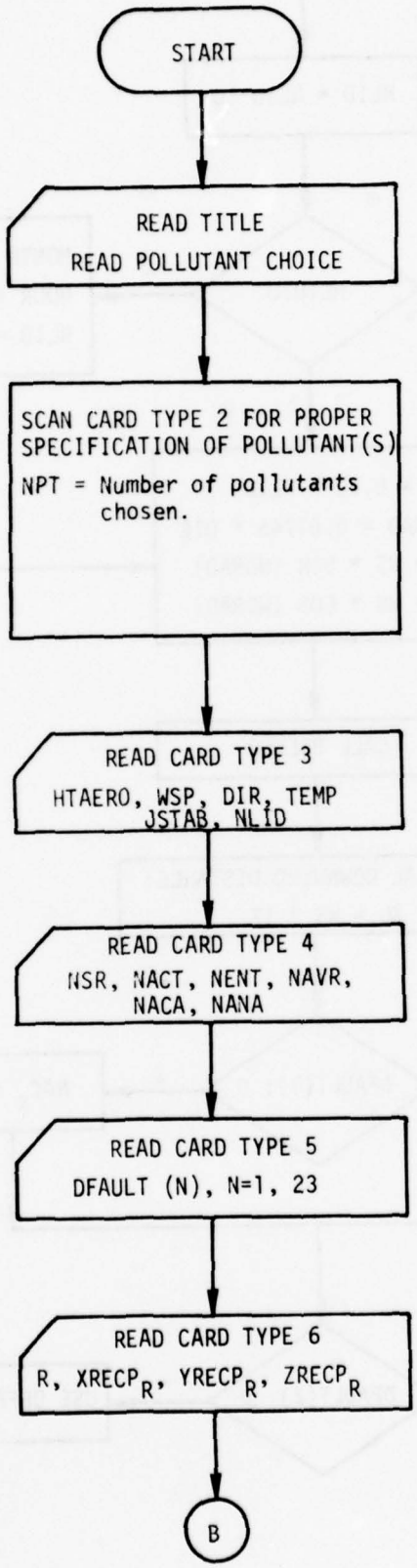
$$\frac{1.22 \times 10^4 \times 1 \times 16}{273} = 715 \times \text{THC conc. (ppm)}$$

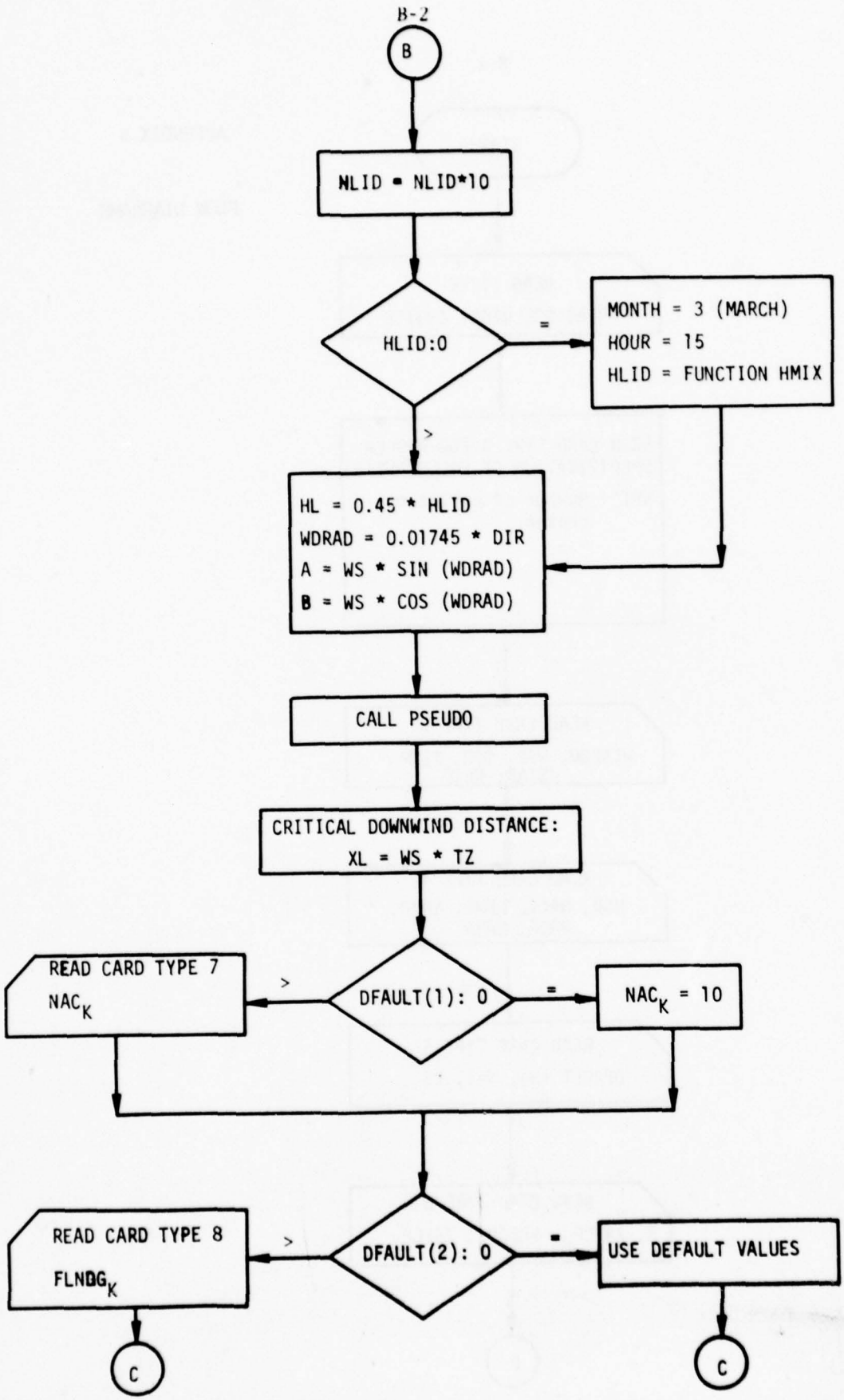
and

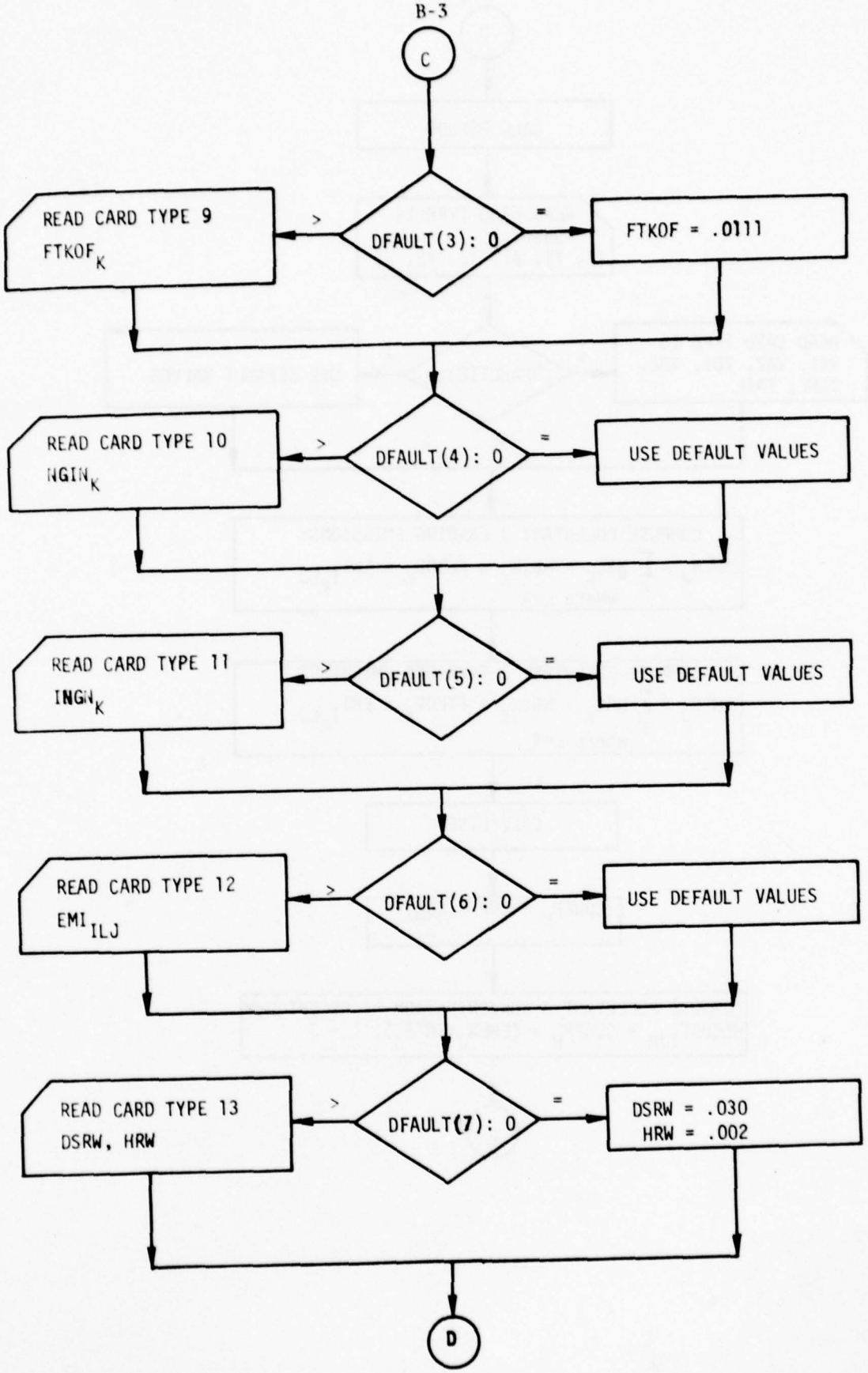
NO_x Concentration ($\mu g/m^3$) (treated as NO_2) = 2056 x NO_x conc. (ppm)

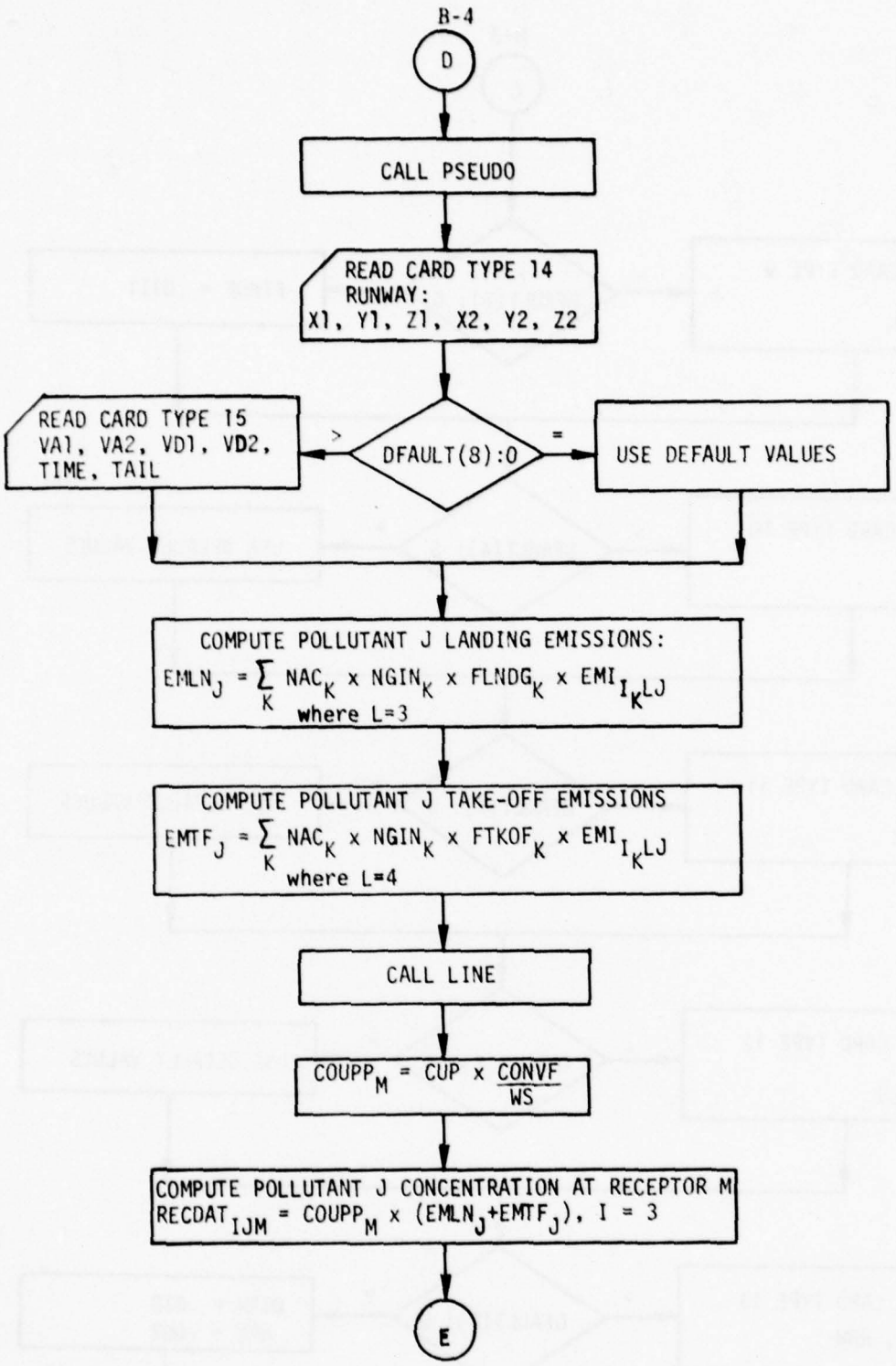
APPENDIX B

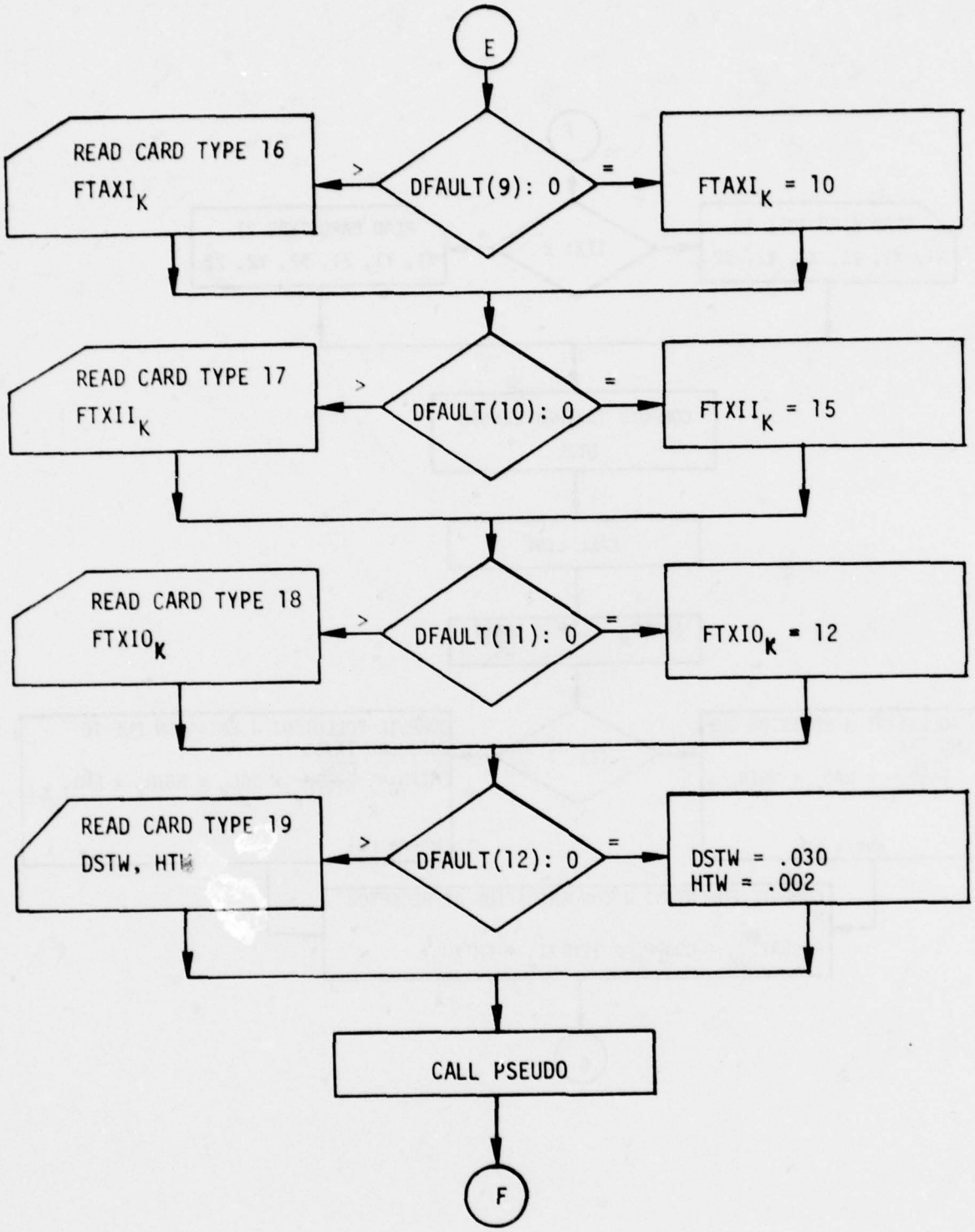
FLOW DIAGRAMS

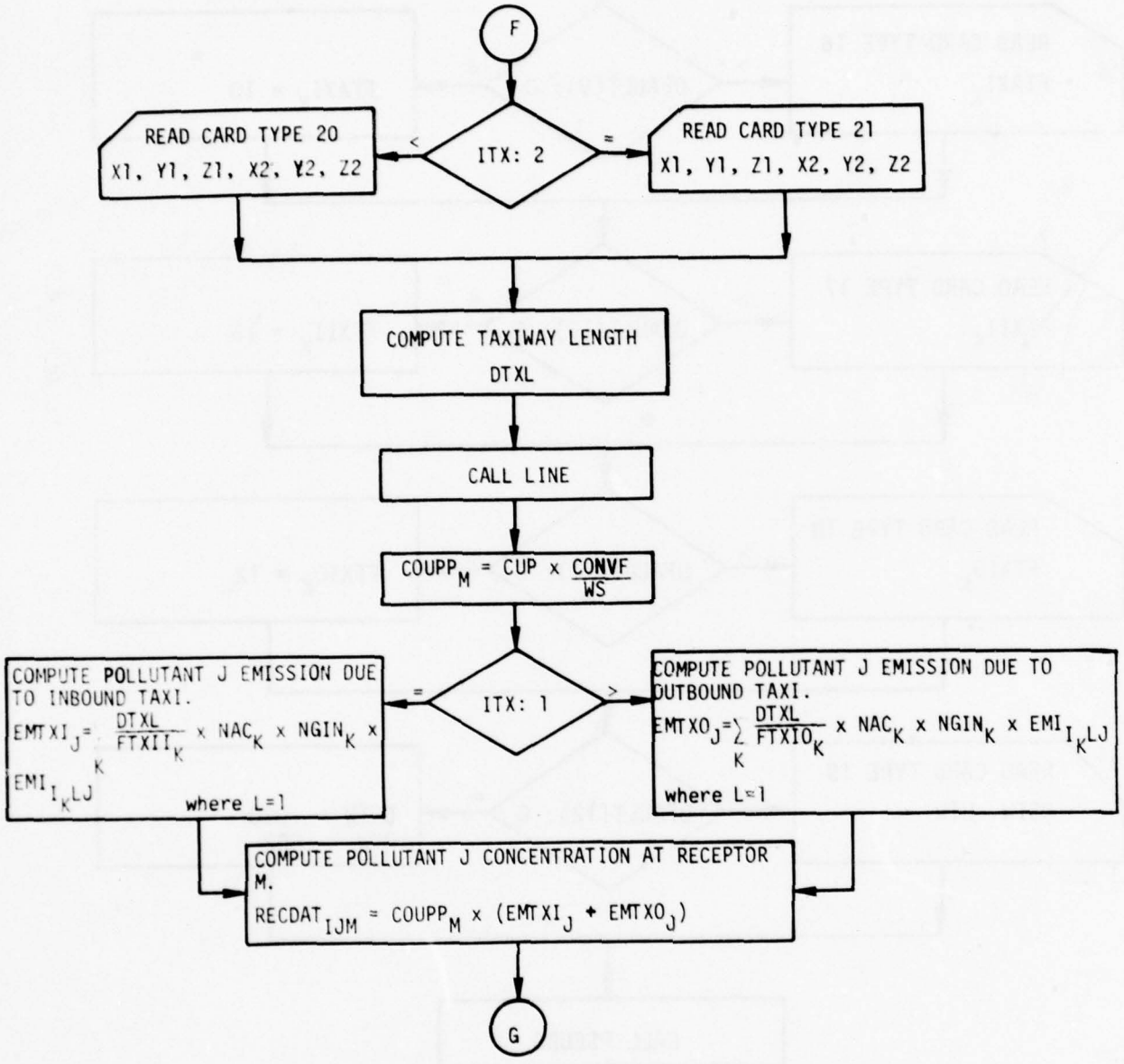


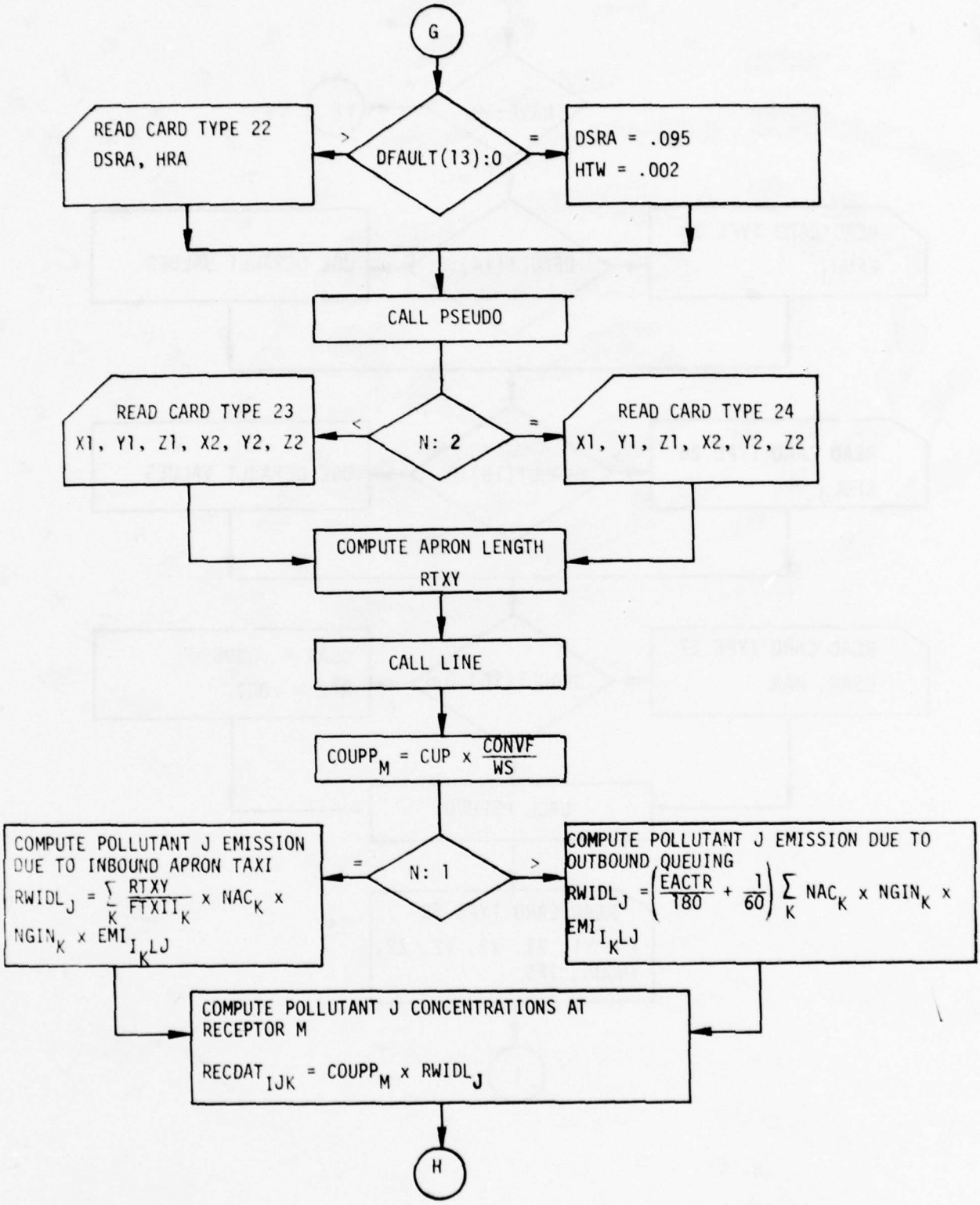

B
NLID = NLID*10
HLID:0
=
MONTH = 3 (MARCH)
HOUR = 15
HLID = FUNCTION HMIX
>
HL = 0.45 * HLID
WDRAD = 0.01745 * DIR
A = WS * SIN (WDRAD)
B = WS * COS (WDRAD)
CALL PSEUDO
CRITICAL DOWNWIND DISTANCE:
XL = WS * TZ
READ CARD TYPE 7
NAC_K
>
DFAULT(1): 0
=
NAC_K = 10
READ CARD TYPE 8
FLNDG_K
>
DFAULT(2): 0
=
USE DEFAULT VALUES
C
C

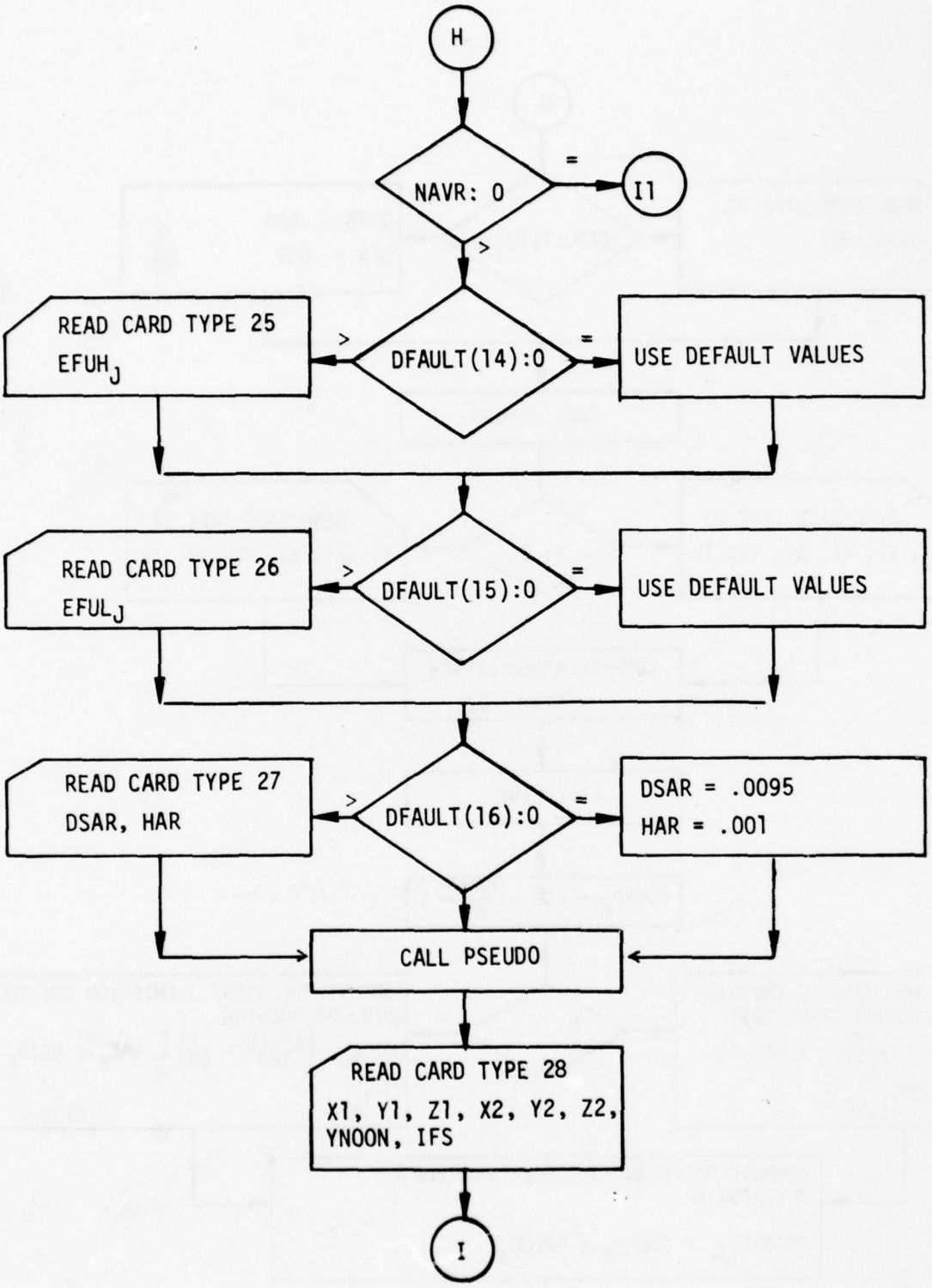

C
READ CARD TYPE 9
FTKOF$_K$
>
DFAULT(3): 0
=
FTKOF = .0111
READ CARD TYPE 10
NGIN$_K$
>
DFAULT(4): 0
=
USE DEFAULT VALUES
READ CARD TYPE 11
INGN$_K$
>
DFAULT(5): 0
=
USE DEFAULT VALUES
READ CARD TYPE 12
EMI$_{ILJ}$
>
DFAULT(6): 0
=
USE DEFAULT VALUES
READ CARD TYPE 13
DSRW, HRW
>
DFAULT(7): 0
=
DSRW = .030
HRW = .002
D

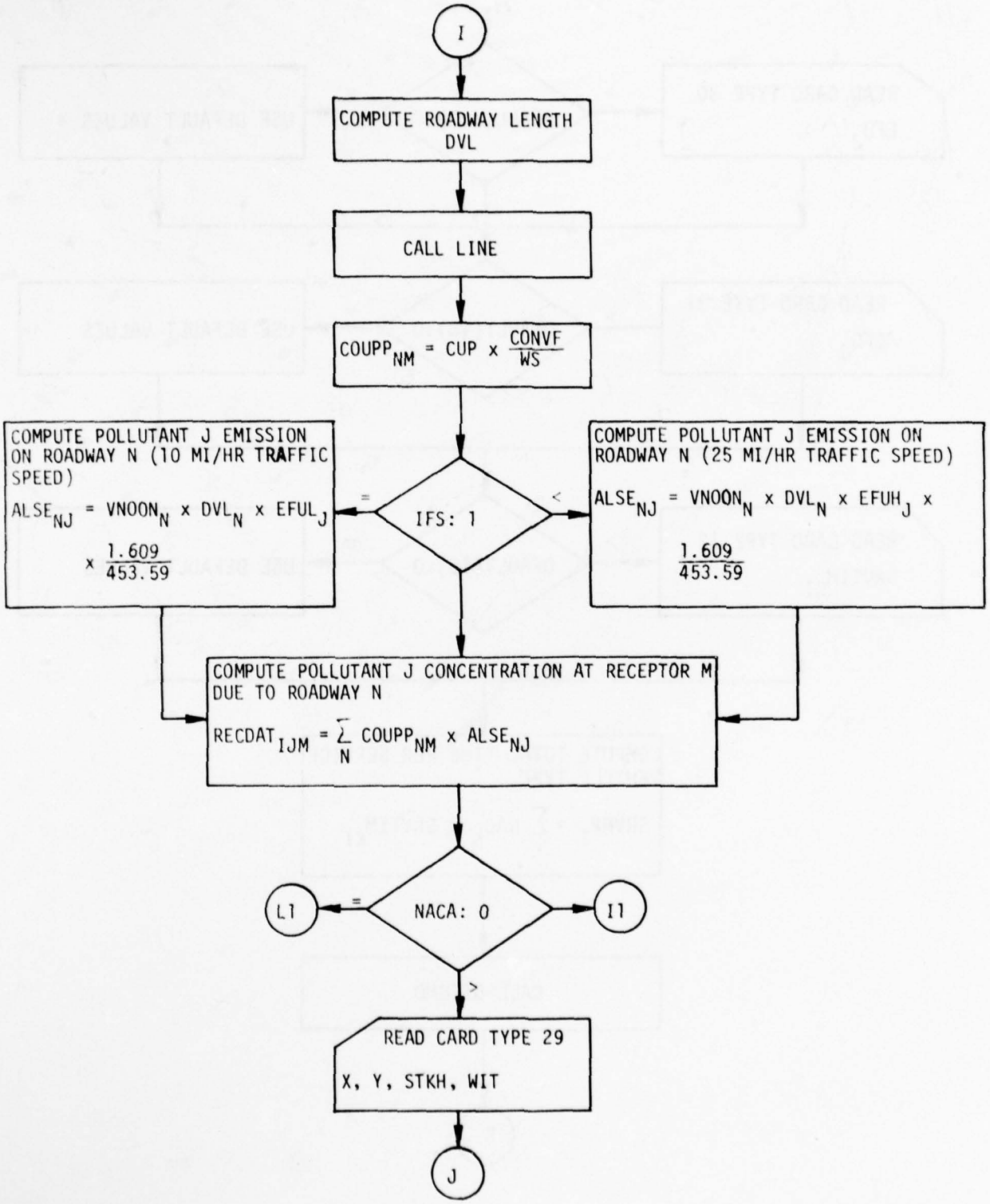

D
CALL PSEUDO
READ CARD TYPE 14
RUNWAY:
X1, Y1, Z1, X2, Y2, Z2
READ CARD TYPE 15
VA1, VA2, VD1, VD2,
TIME, TAIL
>
DFAULT(8):0
=
USE DEFAULT VALUES
COMPUTE POLLUTANT J LANDING EMISSIONS:
$EMLN_J = \sum_K NAC_K \times NGIN_K \times FLNDG_K \times EMI_{I_K LJ}$
where L=3
COMPUTE POLLUTANT J TAKE-OFF EMISSIONS
$EMTF_J = \sum_K NAC_K \times NGIN_K \times FTKOF_K \times EMI_{I_K LJ}$
where L=4
CALL LINE
$COUPP_M = CUP \times \frac{CONVF}{WS}$
COMPUTE POLLUTANT J CONCENTRATION AT RECEPTOR M
$RECDAT_{IJM} = COUPP_M \times (EMLN_J + EMTF_J)$, I = 3
E

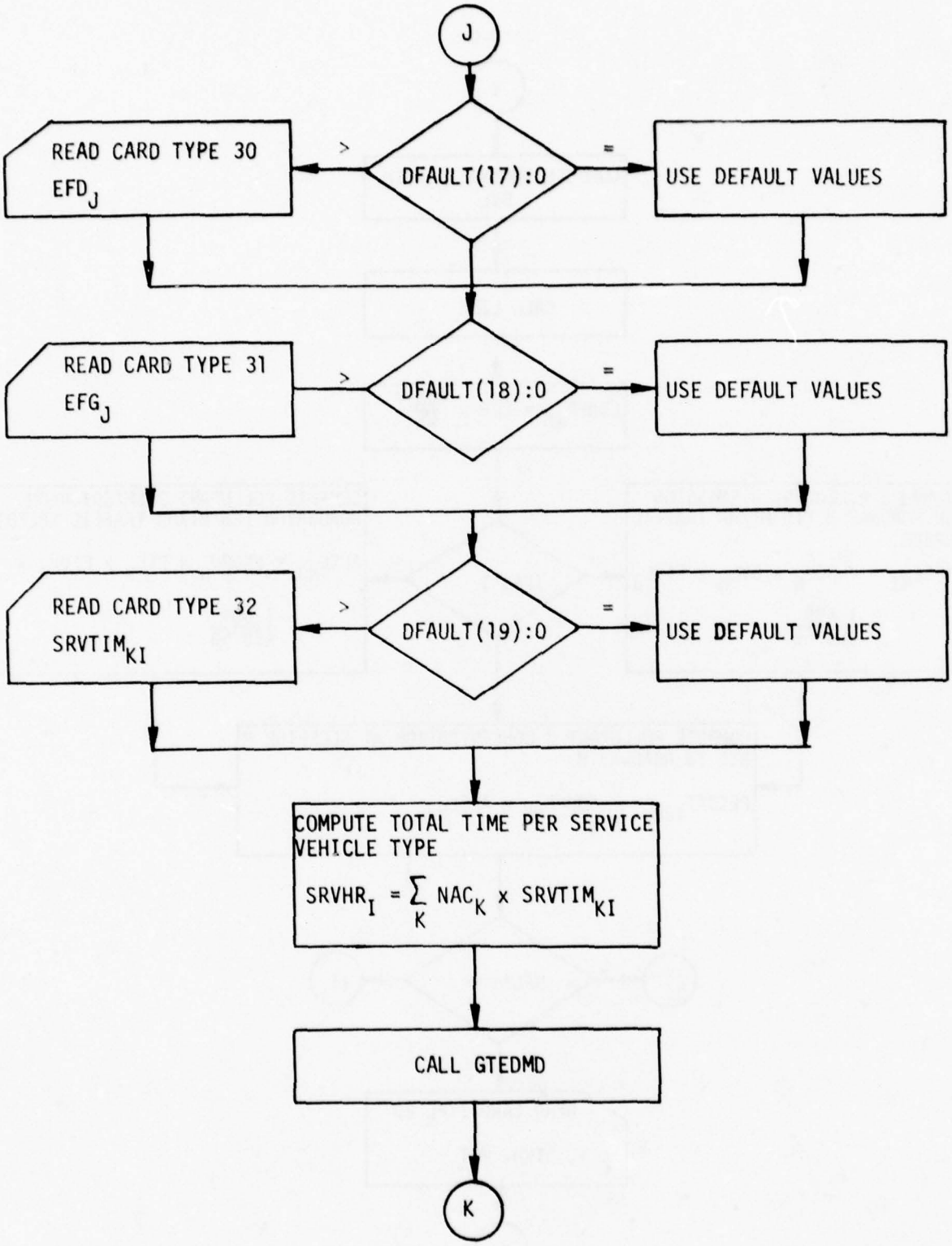

E
READ CARD TYPE 16
FTAXI$_K$
>
DFAULT(9): 0
=
FTAXI$_K$ = 10
READ CARD TYPE 17
FTXII$_K$
>
DFAULT(10): 0
=
FTXII$_K$ = 15
READ CARD TYPE 18
FTXIO$_K$
>
DFAULT(11): 0
=
FTXIO$_K$ = 12
READ CARD TYPE 19
DSTW, HTW
>
DFAULT(12): 0
=
DSTW = .030
HTW = .002
CALL PSEUDO
F

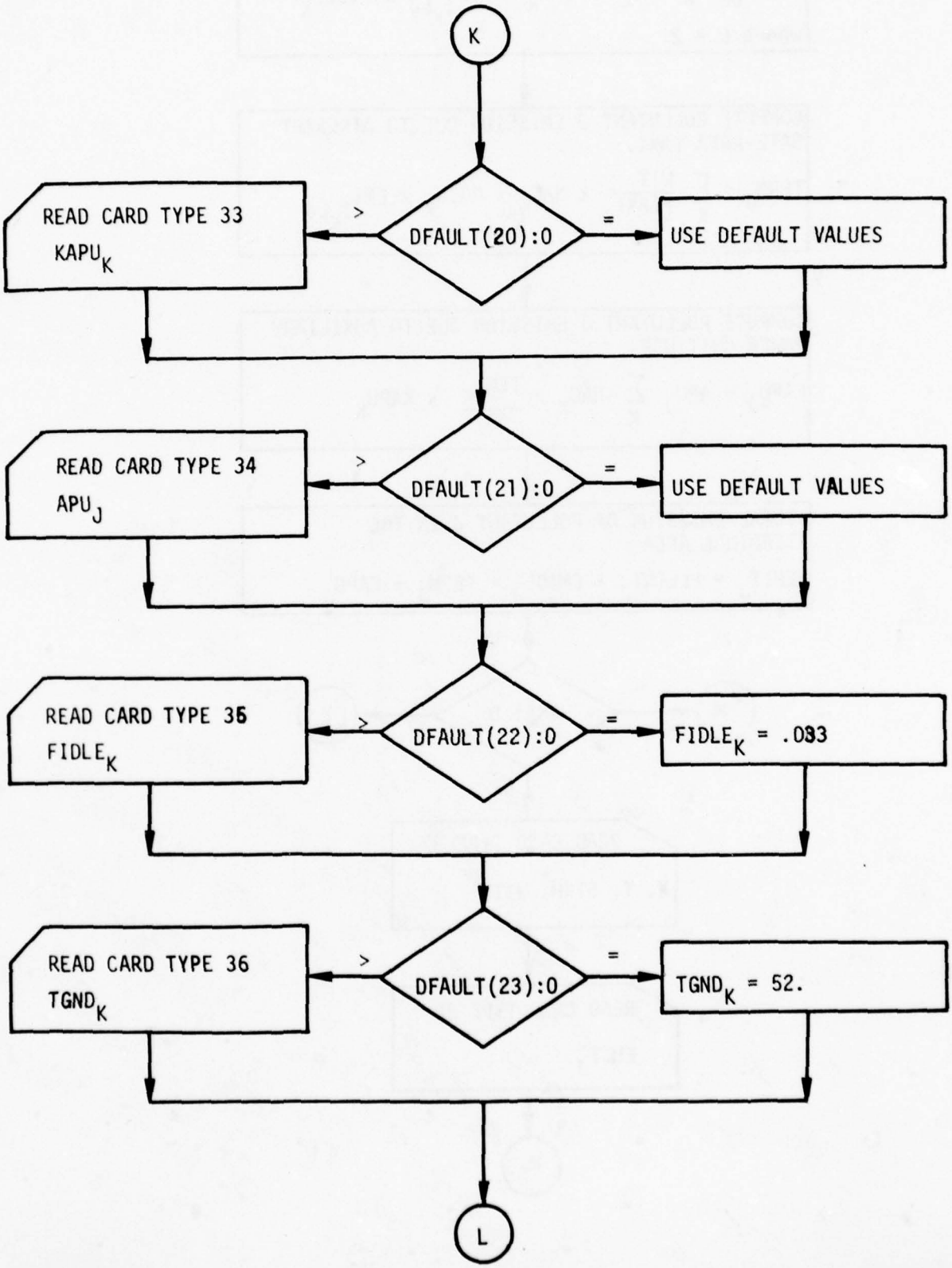

F
ITX: 2
<
=
READ CARD TYPE 20
X1, Y1, Z1, X2, Y2, Z2
READ CARD TYPE 21
X1, Y1, Z1, X2, Y2, Z2
COMPUTE TAXIWAY LENGTH
DTXL
CALL LINE
COUPP_M = CUP x CONVF/WS
ITX: 1
=
>
COMPUTE POLLUTANT J EMISSION DUE TO INBOUND TAXI.
EMTXI_J = Σ_K DTXL/FTXII_K x NAC_K x NGIN_K x EMI_I_K LJ
where L=1
COMPUTE POLLUTANT J EMISSION DUE TO OUTBOUND TAXI.
EMTXO_J = Σ_K DTXL/FTXIO_K x NAC_K x NGIN_K x EMI_I_K LJ
where L=1
COMPUTE POLLUTANT J CONCENTRATION AT RECEPTOR M.
RECDAT_IJM = COUPP_M x (EMTXI_J + EMTXO_J)
G

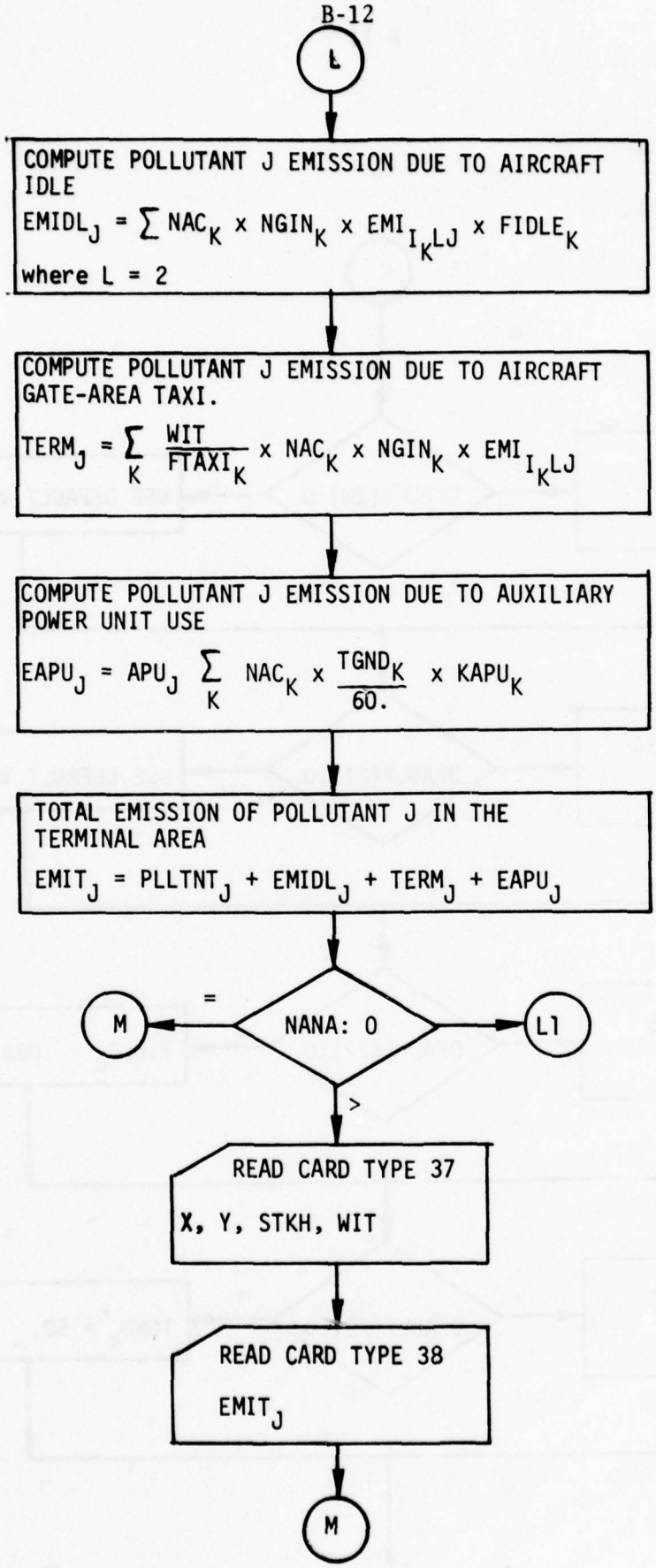

G
READ CARD TYPE 22
DSRA, HRA
>
DFAULT(13):0
=
DSRA = .095
HTW = .002
CALL PSEUDO
READ CARD TYPE 23
X1, Y1, Z1, X2, Y2, Z2
<
N: 2
=
READ CARD TYPE 24
X1, Y1, Z1, X2, Y2, Z2
COMPUTE APRON LENGTH
RTXY
CALL LINE
COUPP_M = CUP x CONVF/WS
COMPUTE POLLUTANT J EMISSION DUE TO INBOUND APRON TAXI
RWIDL_J = Σ_K RTXY/FTXII_K x NAC_K x NGIN_K x EMI_I_K LJ
=
N: 1
>
COMPUTE POLLUTANT J EMISSION DUE TO OUTBOUND QUEUING
RWIDL_J = (EACTR/180 + 1/60) Σ_K NAC_K x NGIN_K x EMI_I_K LJ
COMPUTE POLLUTANT J CONCENTRATIONS AT RECEPTOR M
RECDAT_IJK = COUPP_M x RWIDL_J
H

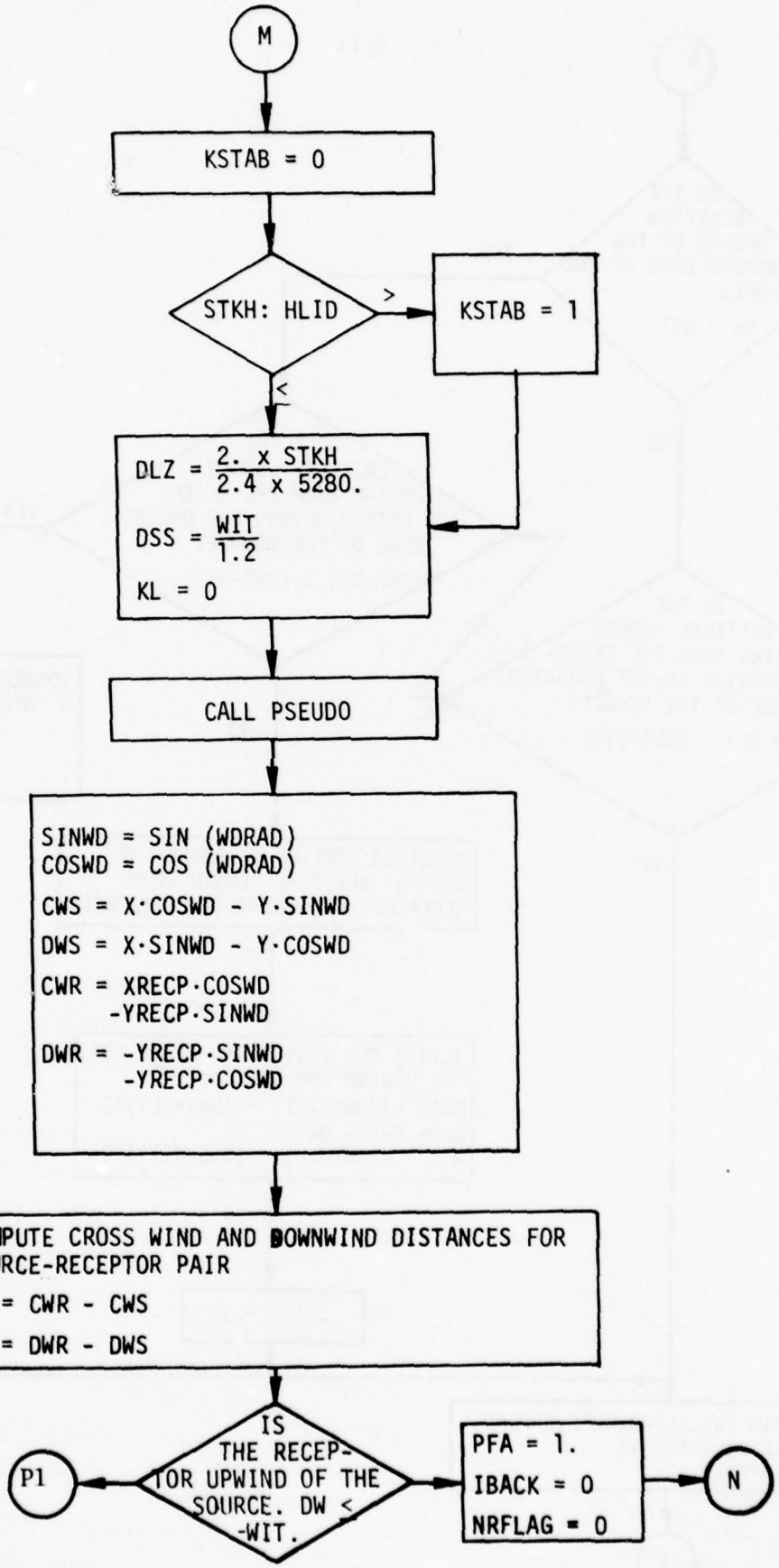

H
NAVR: 0
=
I1
>
READ CARD TYPE 25
EFUH$_J$
>
DFAULT(14):0
=
USE DEFAULT VALUES
READ CARD TYPE 26
EFUL$_J$
>
DFAULT(15):0
=
USE DEFAULT VALUES
READ CARD TYPE 27
DSAR, HAR
>
DFAULT(16):0
=
DSAR = .0095
HAR = .001
CALL PSEUDO
READ CARD TYPE 28
X1, Y1, Z1, X2, Y2, Z2,
YNOON, IFS
I

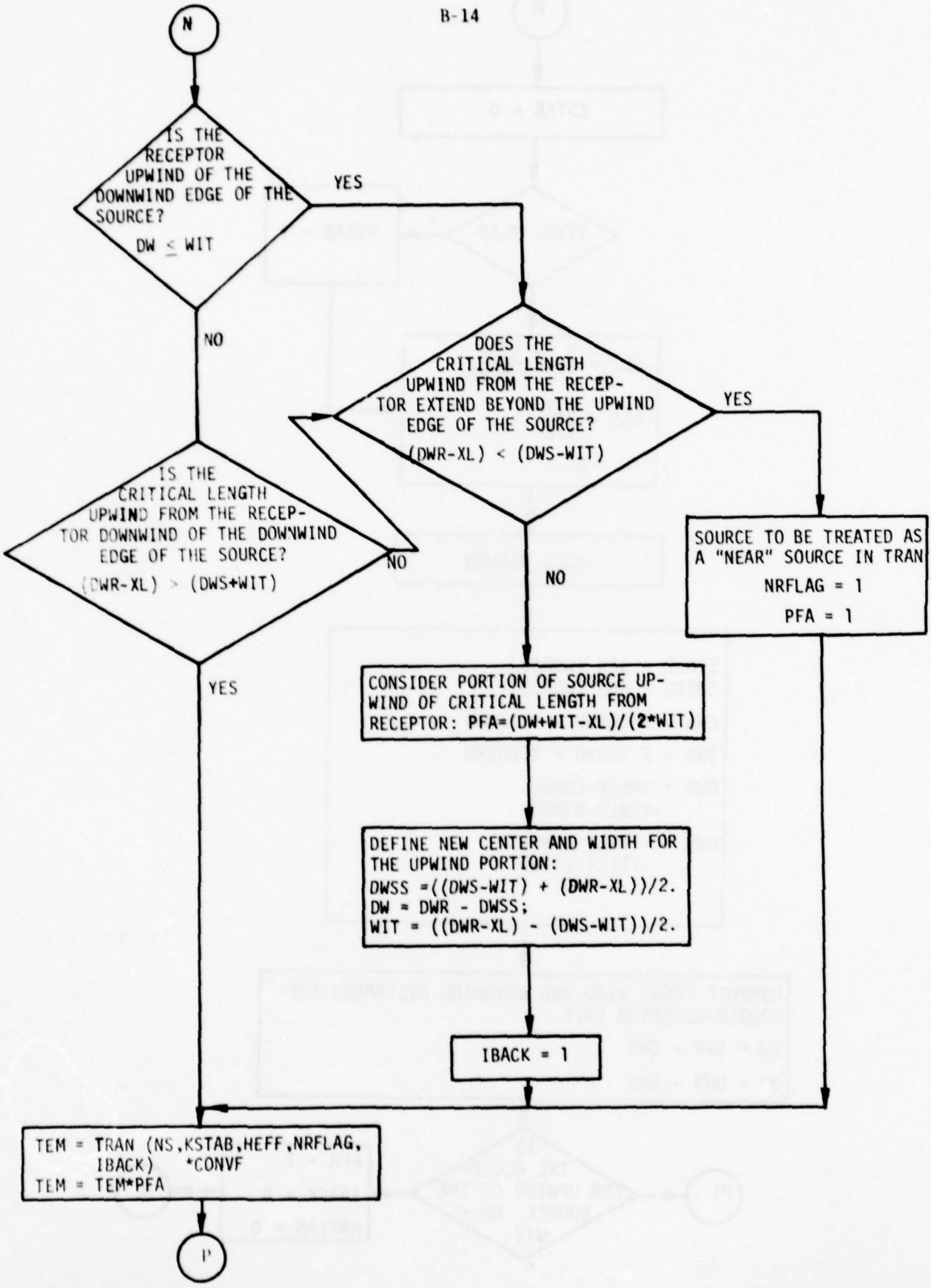

I
COMPUTE ROADWAY LENGTH DVL
CALL LINE
COUPP_NM = CUP x CONVF / WS
COMPUTE POLLUTANT J EMISSION ON ROADWAY N (10 MI/HR TRAFFIC SPEED)
ALSE_NJ = VNOON_N x DVL_N x EFUL_J x 1.609 / 453.59
=
IFS: 1
<
COMPUTE POLLUTANT J EMISSION ON ROADWAY N (25 MI/HR TRAFFIC SPEED)
ALSE_NJ = VNOON_N x DVL_N x EFUH_J x 1.609 / 453.59
COMPUTE POLLUTANT J CONCENTRATION AT RECEPTOR M DUE TO ROADWAY N
RECDAT_IJM = Σ_N COUPP_NM x ALSE_NJ
=
L1
NACA: 0
I1
>
READ CARD TYPE 29
X, Y, STKH, WIT
J

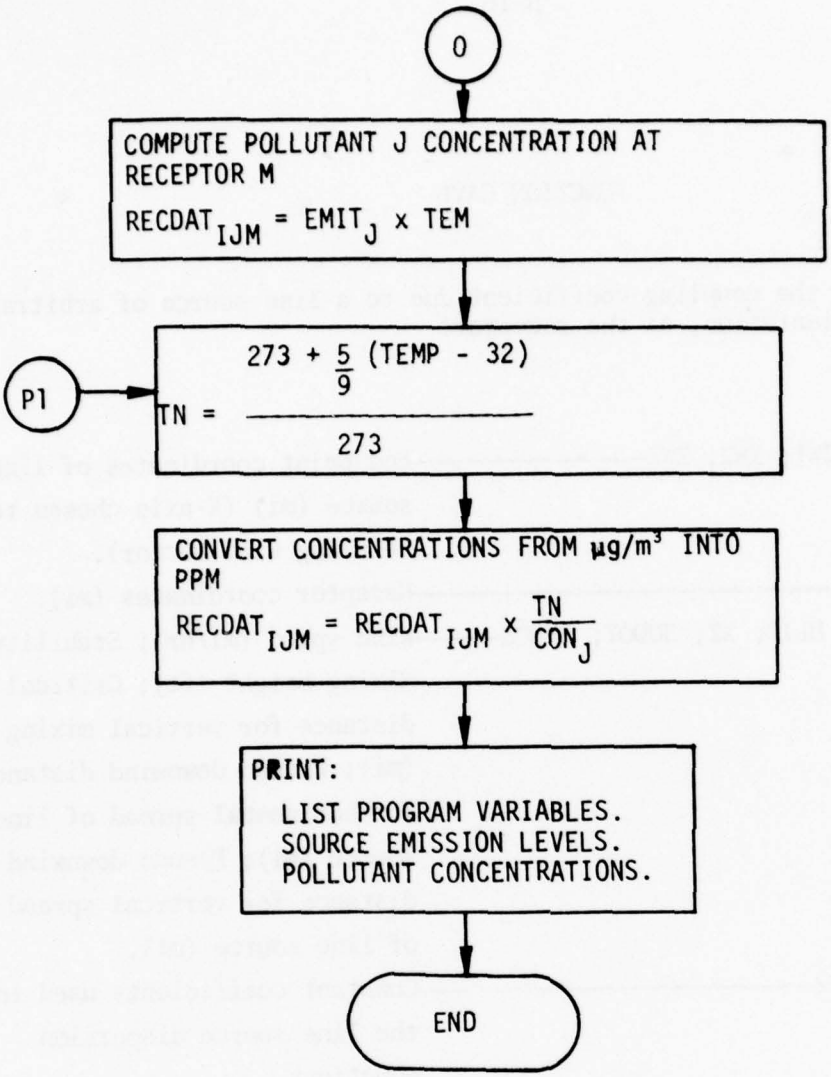

J
READ CARD TYPE 30
EFD$_J$
>
DFAULT(17):0
=
USE DEFAULT VALUES
READ CARD TYPE 31
EFG$_J$
>
DFAULT(18):0
=
USE DEFAULT VALUES
READ CARD TYPE 32
SRVTIM$_{KI}$
>
DFAULT(19):0
=
USE DEFAULT VALUES
COMPUTE TOTAL TIME PER SERVICE VEHICLE TYPE
$SRVHR_I = \sum_K NAC_K \times SRVTIM_{KI}$
CALL GTEDMD
K


K
READ CARD TYPE 33
KAPU$_K$
>
DFAULT(20):0
=
USE DEFAULT VALUES
READ CARD TYPE 34
APU$_J$
>
DFAULT(21):0
=
USE DEFAULT VALUES
READ CARD TYPE 35
FIDLE$_K$
>
DFAULT(22):0
=
FIDLE$_K$ = .083
READ CARD TYPE 36
TGND$_K$
>
DFAULT(23):0
=
TGND$_K$ = 52.
L


L
COMPUTE POLLUTANT J EMISSION DUE TO AIRCRAFT IDLE
EMIDL_J = Σ NAC_K x NGIN_K x EMI_I_K LJ x FIDLE_K
where L = 2
COMPUTE POLLUTANT J EMISSION DUE TO AIRCRAFT GATE-AREA TAXI.
TERM_J = Σ_K WIT / FTAXI_K x NAC_K x NGIN_K x EMI_I_K LJ
COMPUTE POLLUTANT J EMISSION DUE TO AUXILIARY POWER UNIT USE
EAPU_J = APU_J Σ_K NAC_K x TGND_K / 60. x KAPU_K
TOTAL EMISSION OF POLLUTANT J IN THE TERMINAL AREA
EMIT_J = PLLTNT_J + EMIDL_J + TERM_J + EAPU_J
NANA: 0
=
M
L1
>
READ CARD TYPE 37
X, Y, STKH, WIT
READ CARD TYPE 38
EMIT_J
M


M
KSTAB = 0
STKH: HLID
>
KSTAB = 1
<
DLZ = 2. x STKH / 2.4 x 5280.
DSS = WIT / 1.2
KL = 0
CALL PSEUDO
SINWD = SIN (WDRAD)
COSWD = COS (WDRAD)
CWS = X·COSWD - Y·SINWD
DWS = X·SINWD - Y·COSWD
CWR = XRECP·COSWD
-YRECP·SINWD
DWR = -YRECP·SINWD
-YRECP·COSWD
COMPUTE CROSS WIND AND DOWNWIND DISTANCES FOR SOURCE-RECEPTOR PAIR
CW = CWR - CWS
DW = DWR - DWS
IS THE RECEPTOR UPWIND OF THE SOURCE. DW ≤ -WIT.
P1
PFA = 1.
IBACK = 0
NRFLAG = 0
N


N
IS THE RECEPTOR UPWIND OF THE DOWNWIND EDGE OF THE SOURCE?
DW ≤ WIT
YES
NO
DOES THE CRITICAL LENGTH UPWIND FROM THE RECEPTOR EXTEND BEYOND THE UPWIND EDGE OF THE SOURCE?
(DWR-XL) < (DWS-WIT)
YES
NO
IS THE CRITICAL LENGTH UPWIND FROM THE RECEPTOR DOWNWIND OF THE DOWNWIND EDGE OF THE SOURCE?
(DWR-XL) > (DWS+WIT)
NO
YES
SOURCE TO BE TREATED AS A "NEAR" SOURCE IN TRAN
NRFLAG = 1
PFA = 1
CONSIDER PORTION OF SOURCE UPWIND OF CRITICAL LENGTH FROM RECEPTOR: PFA=(DW+WIT-XL)/(2*WIT)
DEFINE NEW CENTER AND WIDTH FOR THE UPWIND PORTION:
DWSS =((DWS-WIT) + (DWR-XL))/2.
DW = DWR - DWSS;
WIT = ((DWR-XL) - (DWS-WIT))/2.
IBACK = 1
TEM = TRAN (NS,KSTAB,HEFF,NRFLAG, IBACK) *CONVF
TEM = TEM*PFA
P


0
COMPUTE POLLUTANT J CONCENTRATION AT RECEPTOR M
RECDAT IJM = EMIT J x TEM
P1
TN = 273 + 5/9 (TEMP - 32) / 273
CONVERT CONCENTRATIONS FROM µg/m3 INTO PPM
RECDAT IJM = RECDAT IJM x TN / CON J
PRINT:
LIST PROGRAM VARIABLES.
SOURCE EMISSION LEVELS.
POLLUTANT CONCENTRATIONS.
END

FUNCTION CAVL

Purpose:

To compute the coupling coefficient due to a line source of arbitrary spatial orientation, at the receptor.

Input:

XW1, YW1, ZW1; XW2, ZW2	End-point coordinates of line source (mi) (X-axis chosen to be along wind vector).
XR, YR, ZR	Receptor coordinates (mi).
WS; JSTAB; HLID; XZ; SUDOY; SUDOZ	Wind speed (mi/hr); Stability; Mixing height (ft); Critical distance for vertical mixing (mi); Pseudo downwind distance for horizontal spread of line source (mi); Pseudo downwind distance for vertical spread of line source (mi).
COEF1; COEF2	Constant coefficients used in the line source dispersion equations.

Output:

CAVL (XR, YR, ZR)	Coupling coefficient (mi^{-2}) at the receptor point (XR, YR, ZR).

Procedure:

1. Test whether the receptor is located with respect to the line source such that the concentration is completely negligible.
2. If angle between wind vector and line is sufficiently small, and line source is sufficiently long, a flag is set for the line to be segmented. Each segment is then treated as an individual line.
3. Compute effective downwind distance.
4. Compute horizontal and vertical dispersion coefficients, using external function routines SIGY and SIGZ.
5. Compute the Z-component of the dispersion expression.

6. Test whether the line source has a uniform density. If it is a runway used for aircraft arrival or departure (nonuniform line density), subroutine QMOD is called.

7. Compute and output the concentration for the given receptor.

Functions Called:

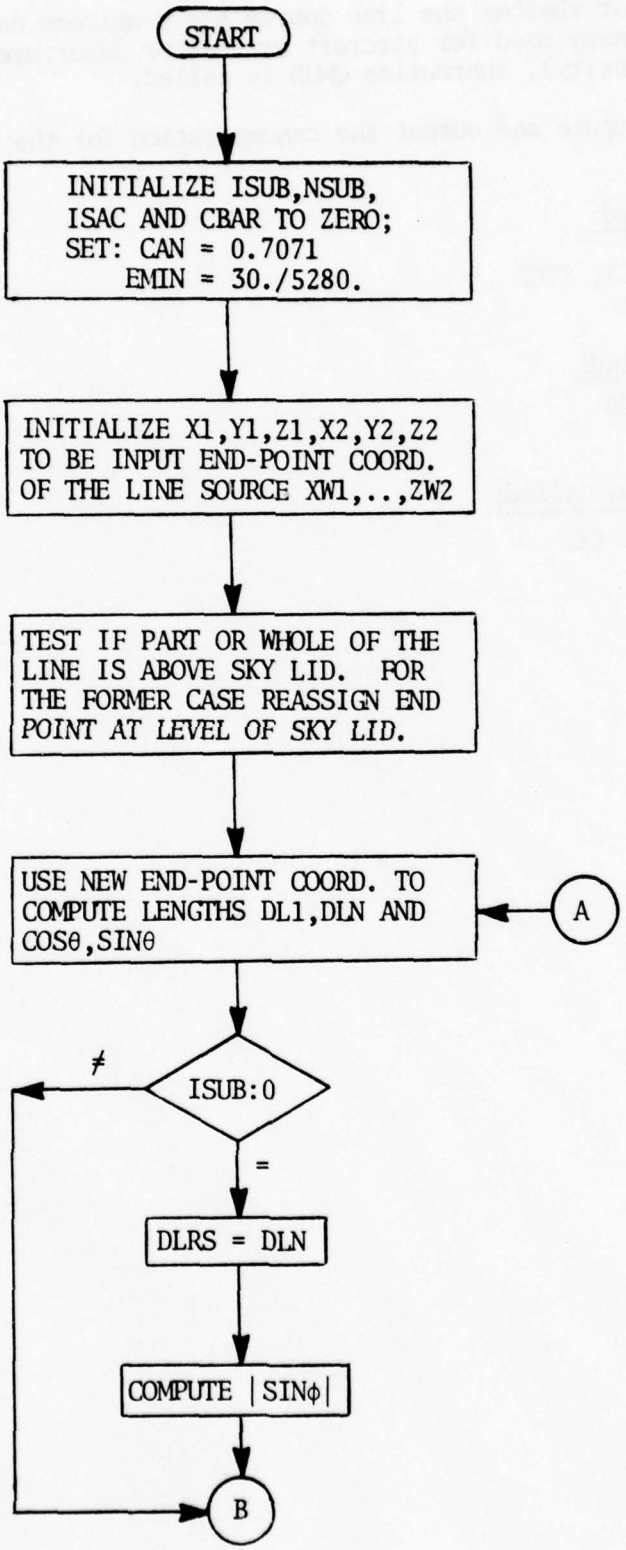
SIGY, SIGZ

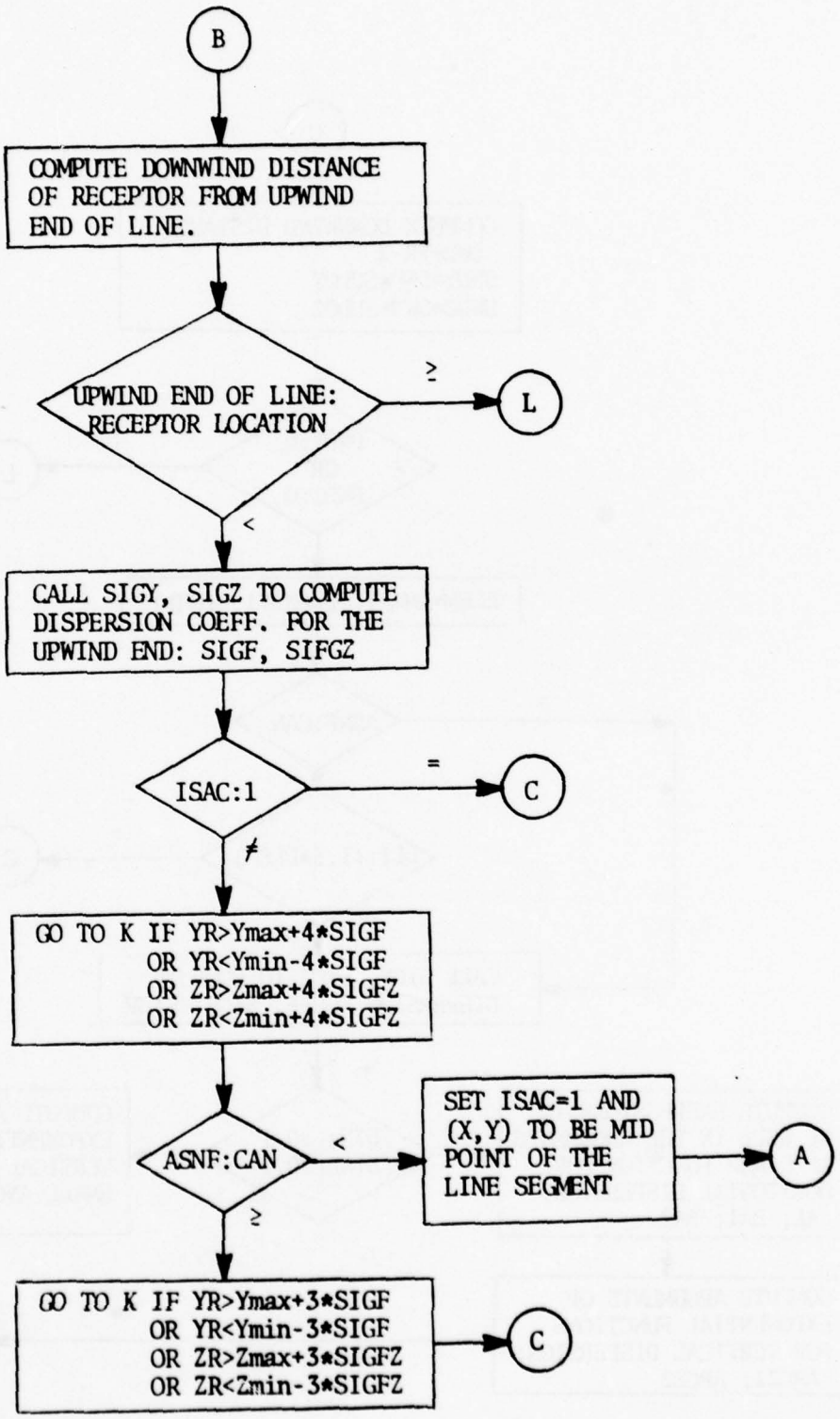
Subroutine Called:

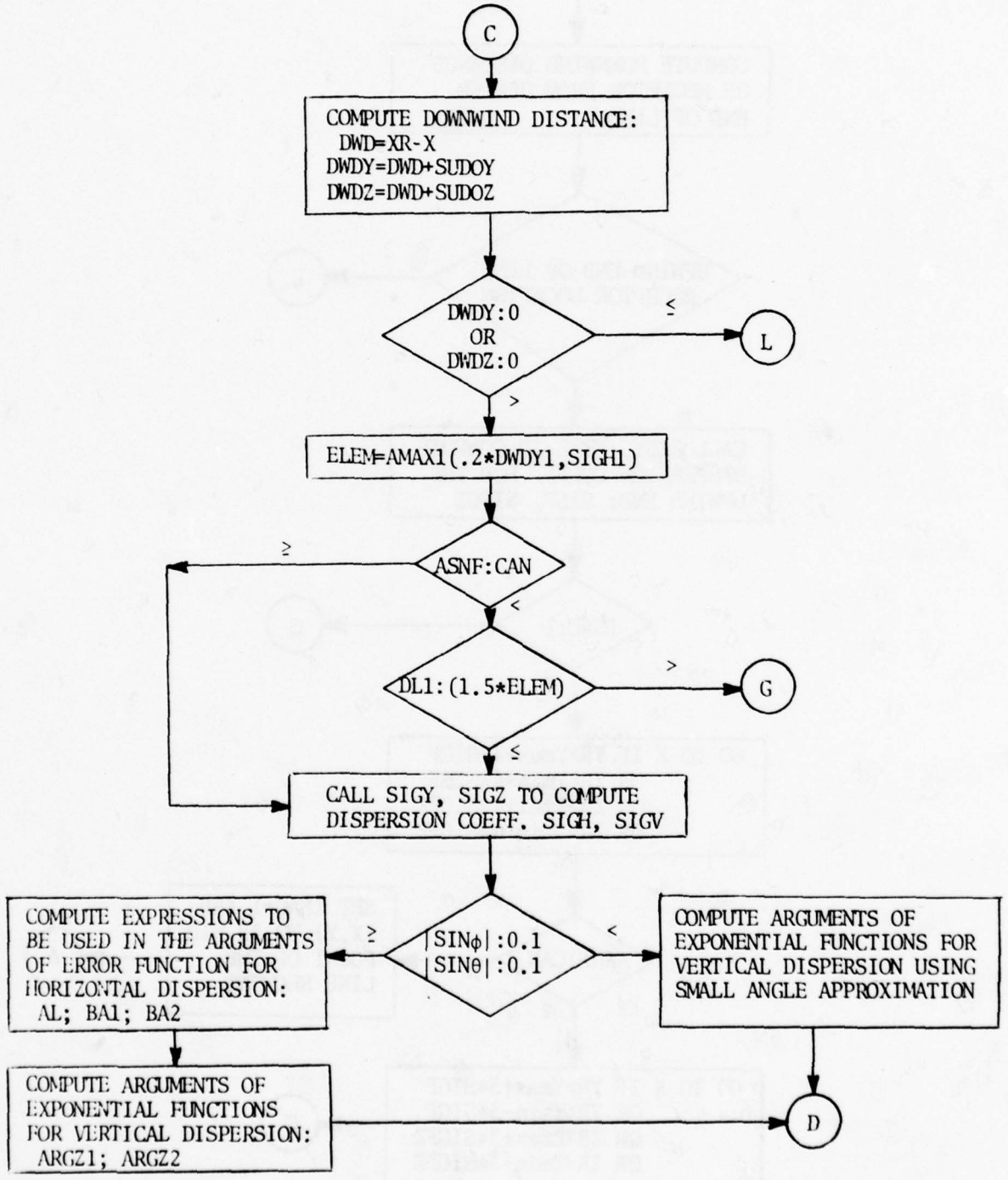
QMOD

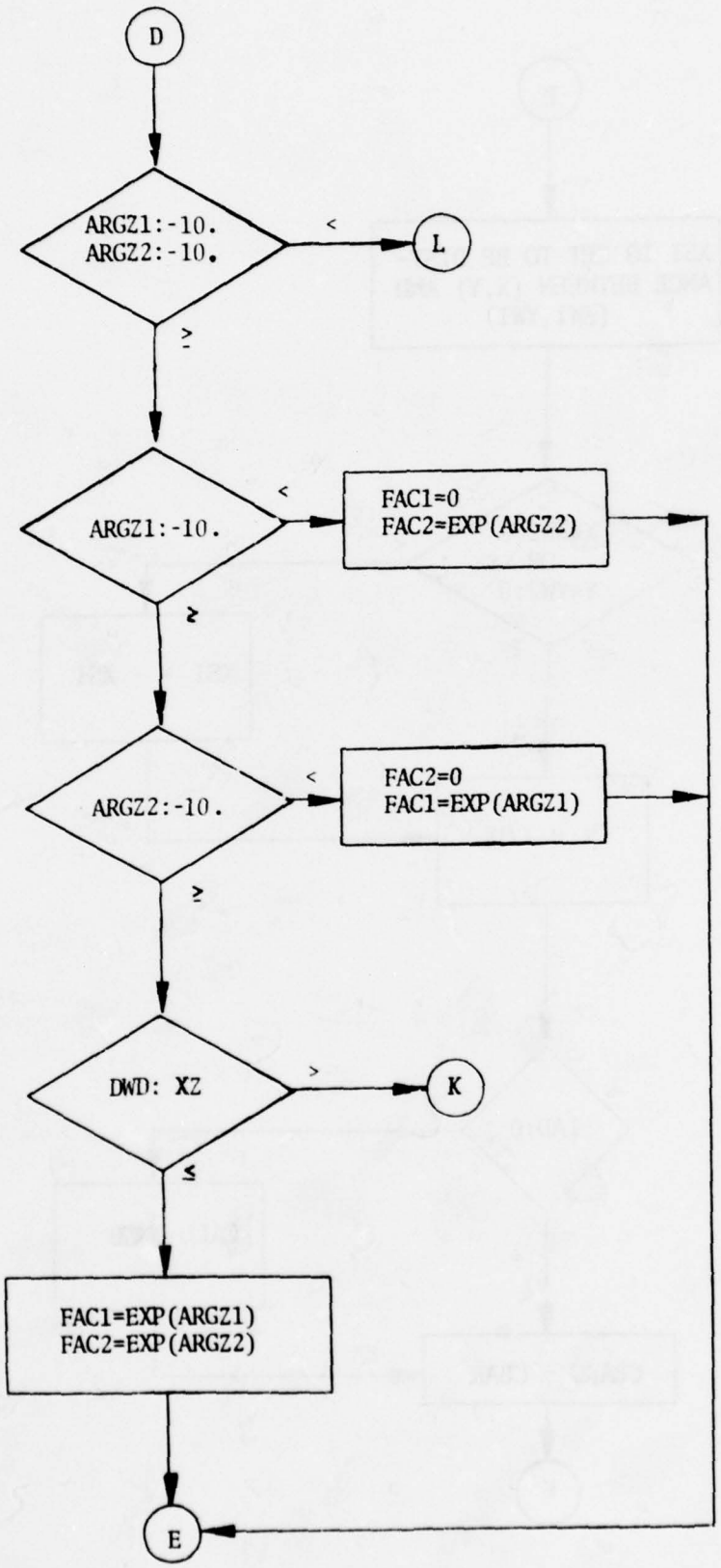
Special Function Called:

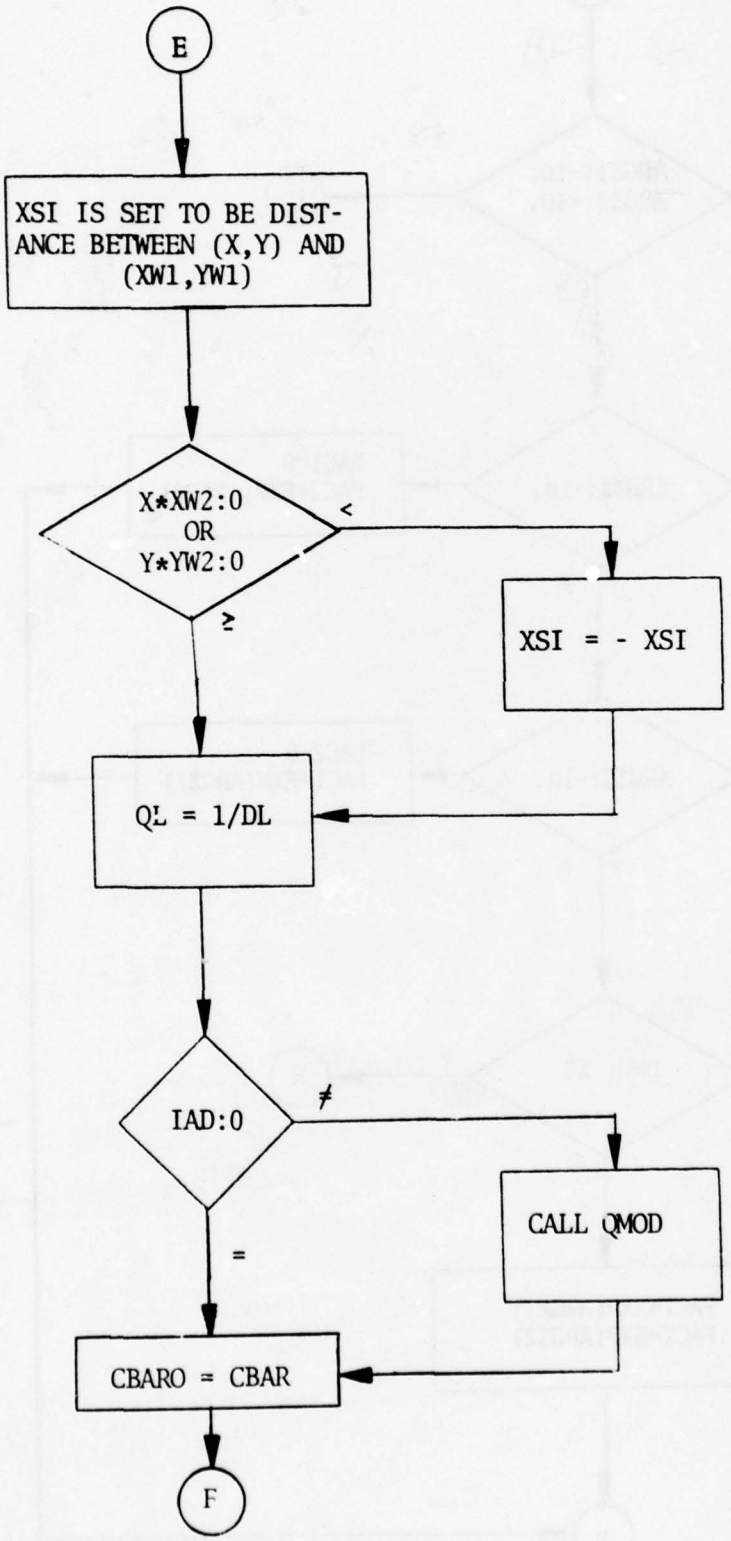
ERF (X)

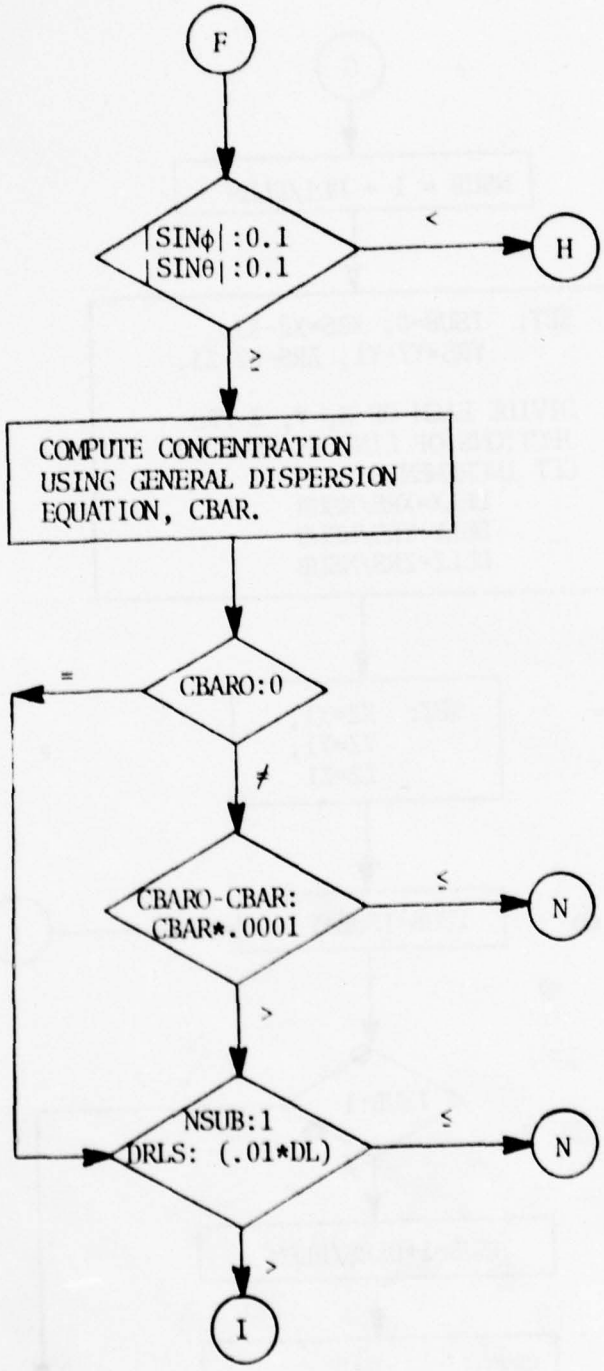

START
INITIALIZE ISUB,NSUB, ISAC AND CBAR TO ZERO; SET: CAN = 0.7071 EMIN = 30./5280.
INITIALIZE X1,Y1,Z1,X2,Y2,Z2 TO BE INPUT END-POINT COORD. OF THE LINE SOURCE XW1,..,ZW2
TEST IF PART OR WHOLE OF THE LINE IS ABOVE SKY LID. FOR THE FORMER CASE REASSIGN END POINT AT LEVEL OF SKY LID.
USE NEW END-POINT COORD. TO COMPUTE LENGTHS DL1,DLN AND COSθ,SINθ
A
≠
ISUB:0
=
DLRS = DLN
COMPUTE |SINφ|
B

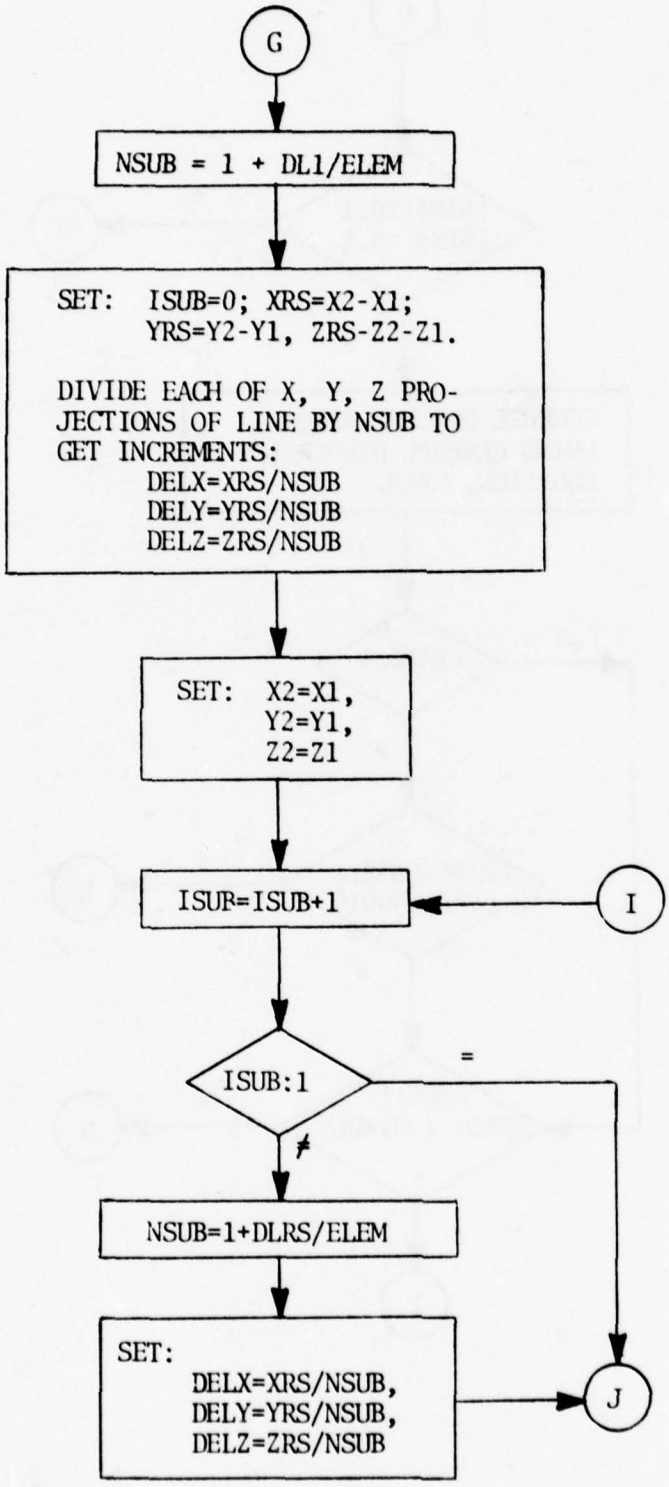

B
COMPUTE DOWNWIND DISTANCE OF RECEPTOR FROM UPWIND END OF LINE.
UPWIND END OF LINE: RECEPTOR LOCATION
≥
L
<
CALL SIGY, SIGZ TO COMPUTE DISPERSION COEFF. FOR THE UPWIND END: SIGF, SIFGZ
ISAC:1
=
C
≠
GO TO K IF YR>Ymax+4*SIGF
OR YR<Ymin-4*SIGF
OR ZR>Zmax+4*SIGFZ
OR ZR<Zmin+4*SIGFZ
ASNF:CAN
<
SET ISAC=1 AND (X,Y) TO BE MID POINT OF THE LINE SEGMENT
A
≥
GO TO K IF YR>Ymax+3*SIGF
OR YR<Ymin-3*SIGF
OR ZR>Zmax+3*SIGFZ
OR ZR<Zmin-3*SIGFZ
C

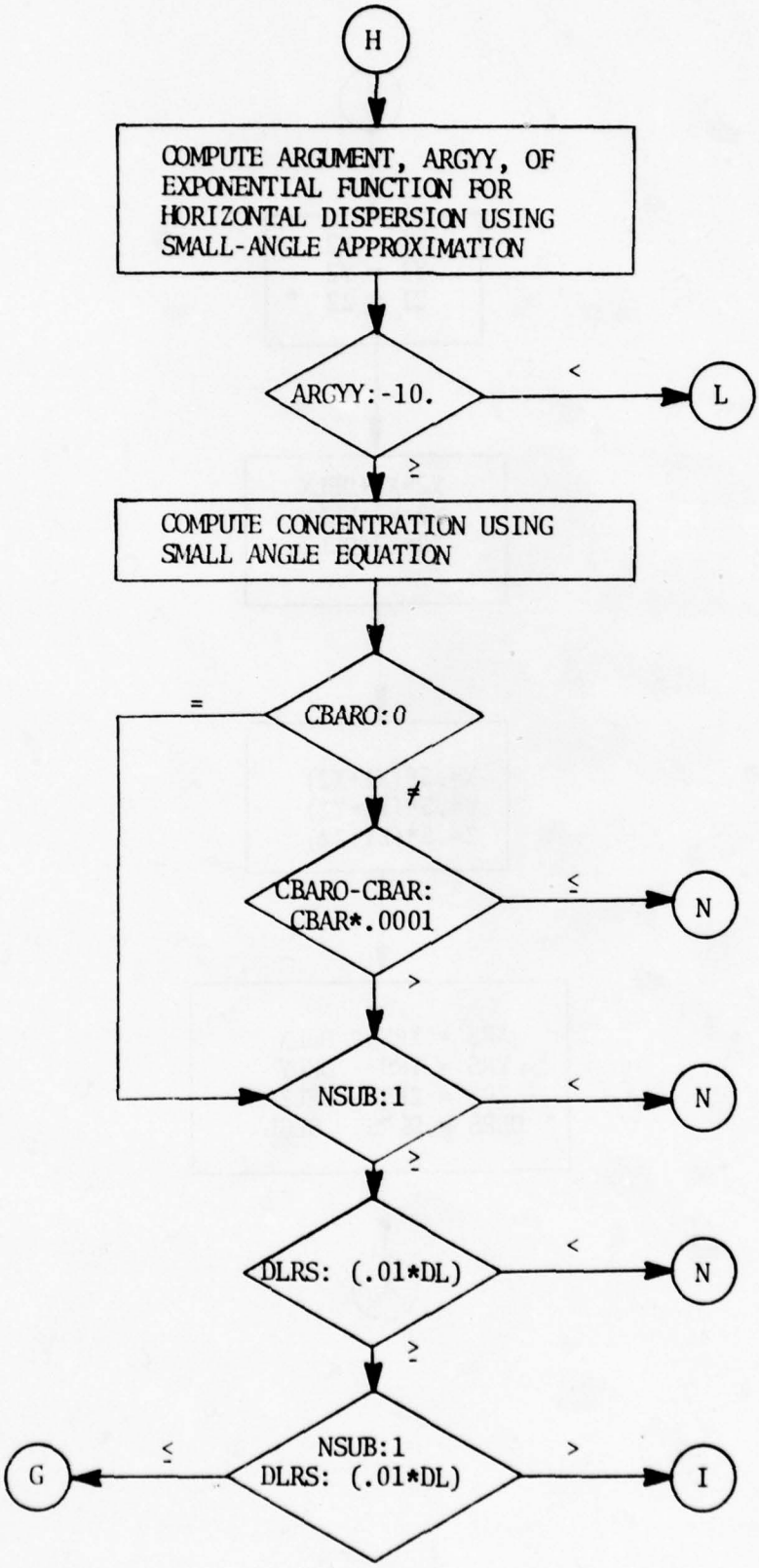

C
COMPUTE DOWNWIND DISTANCE:
DWD=XR-X
DWDY=DWD+SUDOY
DWDZ=DWD+SUDOZ
DWDY:0
OR
DWDZ:0
≤
L
>
ELEM=AMAX1(.2*DWDY1,SIGH1)
≥
ASNF:CAN
<
DL1:(1.5*ELEM)
>
G
≤
CALL SIGY, SIGZ TO COMPUTE
DISPERSION COEFF. SIGH, SIGV
COMPUTE EXPRESSIONS TO
BE USED IN THE ARGUMENTS
OF ERROR FUNCTION FOR
HORIZONTAL DISPERSION:
AL; BA1; BA2
≥
|SINφ|:0.1
|SINθ|:0.1
<
COMPUTE ARGUMENTS OF
EXPONENTIAL FUNCTIONS FOR
VERTICAL DISPERSION USING
SMALL ANGLE APPROXIMATION
COMPUTE ARGUMENTS OF
EXPONENTIAL FUNCTIONS
FOR VERTICAL DISPERSION:
ARGZ1; ARGZ2
D

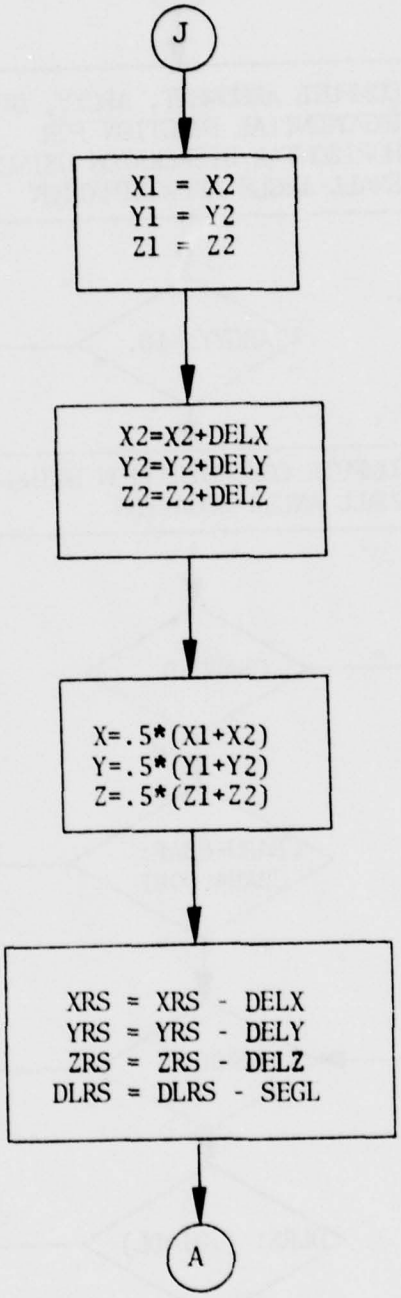

D
ARGZ1:-10.
ARGZ2:-10.
<
L
≥
ARGZ1:-10.
<
FAC1=0
FAC2=EXP(ARGZ2)
≥
ARGZ2:-10.
<
FAC2=0
FAC1=EXP(ARGZ1)
≥
DWD: XZ
>
K
≤
FAC1=EXP(ARGZ1)
FAC2=EXP(ARGZ2)
E

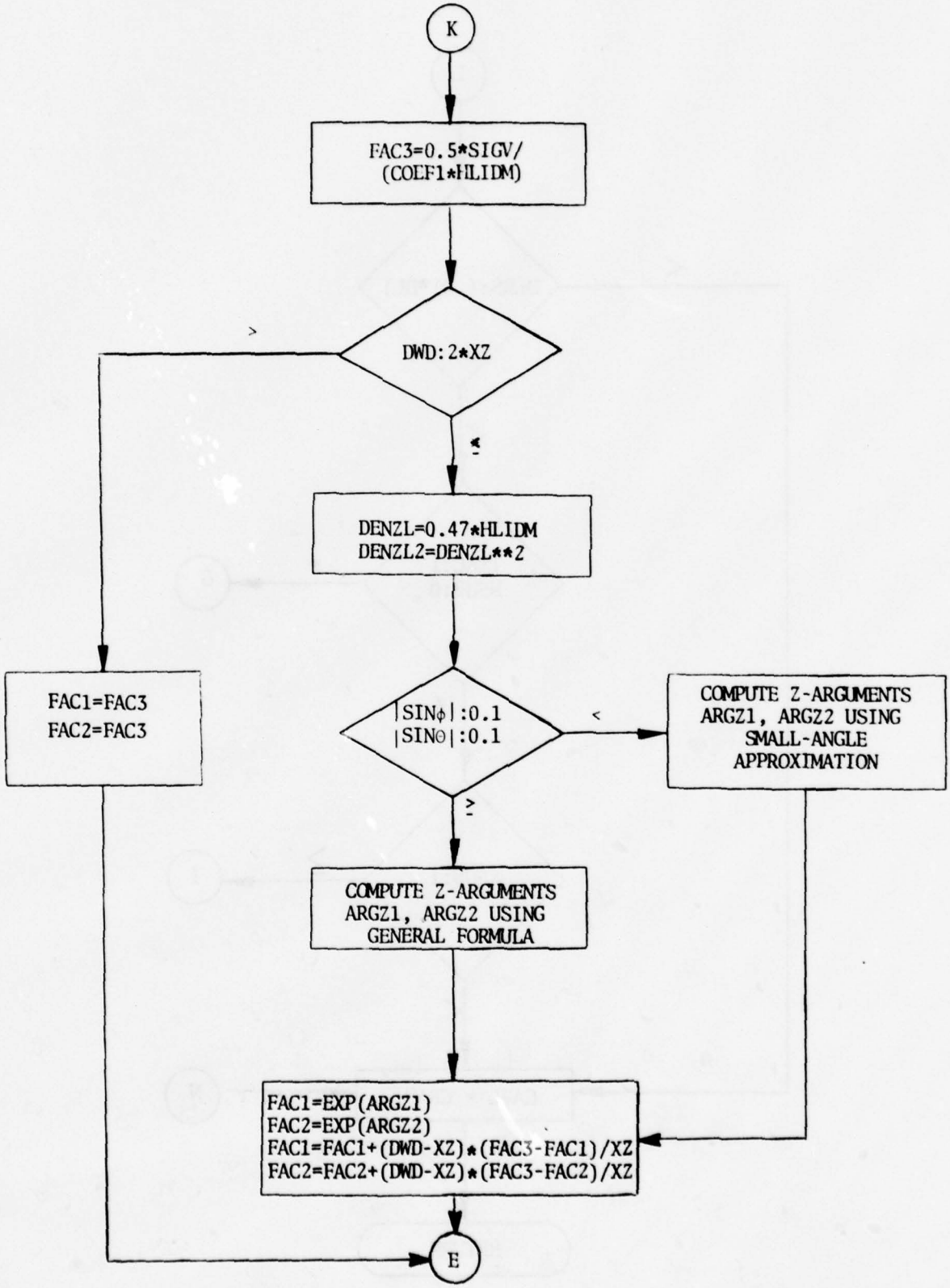

E
XSI IS SET TO BE DISTANCE BETWEEN (X,Y) AND (XW1,YW1)
X*XW2:0 OR Y*YW2:0
<
≥
XSI = - XSI
QL = 1/DL
IAD:0
≠
=
CALL QMOD
CBARO = CBAR
F

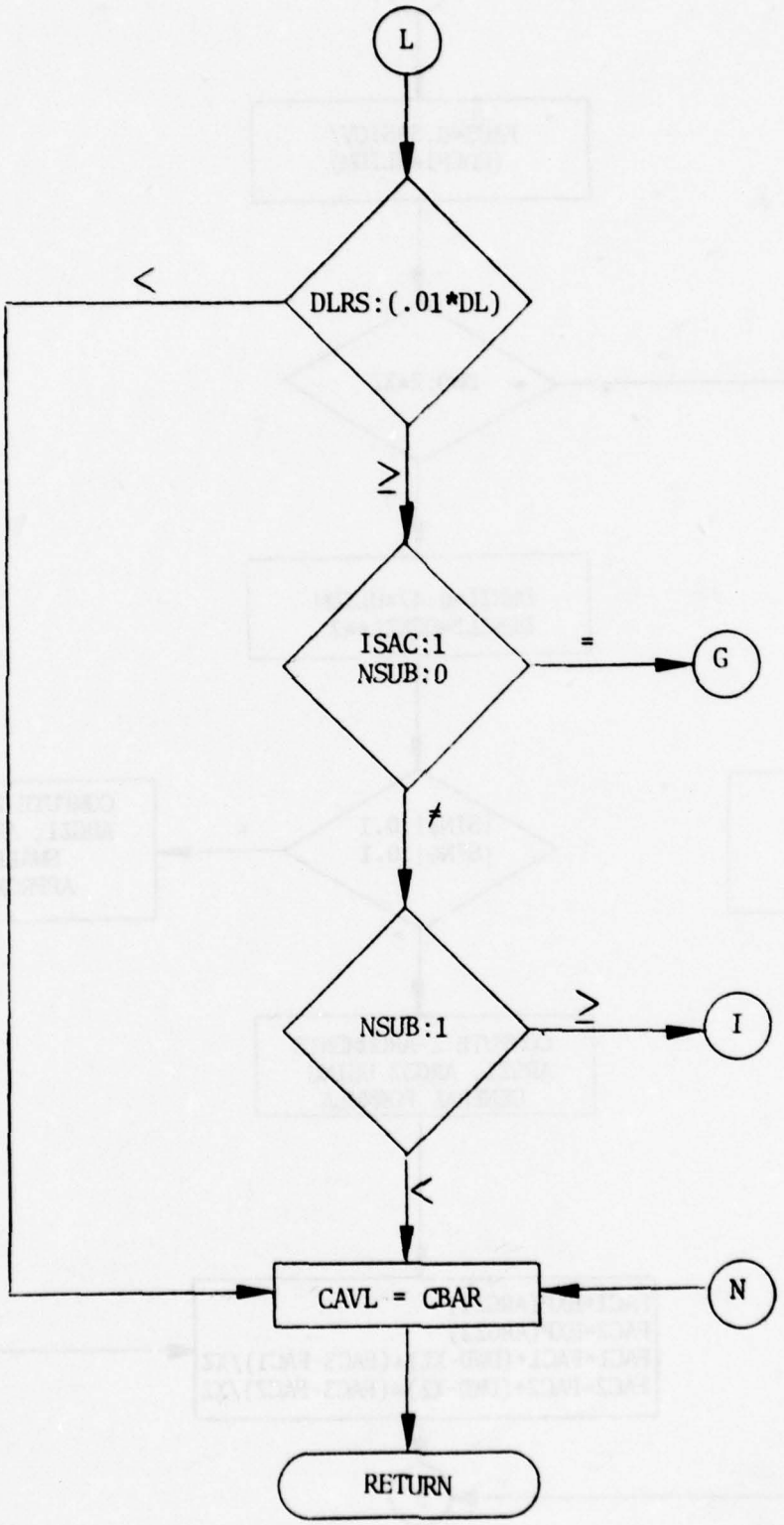

F
|SINφ| : 0.1
|SINθ| : 0.1
<
H
≥
COMPUTE CONCENTRATION
USING GENERAL DISPERSION
EQUATION, CBAR.
CBARO : 0
=
≠
CBARO-CBAR:
CBAR*.0001
≤
N
>
NSUB : 1
DRLS: (.01*DL)
≤
N
>
I


G
NSUB = 1 + DL1/ELEM
SET: ISUB=0; XRS=X2-X1;
YRS=Y2-Y1, ZRS-Z2-Z1.
DIVIDE EACH OF X, Y, Z PRO-
JECTIONS OF LINE BY NSUB TO
GET INCREMENTS:
DELX=XRS/NSUB
DELY=YRS/NSUB
DELZ=ZRS/NSUB
SET: X2=X1,
Y2=Y1,
Z2=Z1
ISUB=ISUB+1
I
ISUB:1
=
≠
NSUB=1+DLRS/ELEM
SET:
DELX=XRS/NSUB,
DELY=YRS/NSUB,
DELZ=ZRS/NSUB
J


H
COMPUTE ARGUMENT, ARGYY, OF EXPONENTIAL FUNCTION FOR HORIZONTAL DISPERSION USING SMALL-ANGLE APPROXIMATION
ARGYY:-10.
<
L
≥
COMPUTE CONCENTRATION USING SMALL ANGLE EQUATION
CBARO:0
=
≠
CBARO-CBAR: CBAR*.0001
≤
N
>
NSUB:1
<
N
≥
DLRS: (.01*DL)
<
N
≥
NSUB:1 DLRS: (.01*DL)
≤
G
>
I


J
X1 = X2
Y1 = Y2
Z1 = Z2
X2=X2+DELX
Y2=Y2+DELY
Z2=Z2+DELZ
X=.5*(X1+X2)
Y=.5*(Y1+Y2)
Z=.5*(Z1+Z2)
XRS = XRS - DELX
YRS = YRS - DELY
ZRS = ZRS - DELZ
DLRS = DLRS - SEGL
A


K
FAC3=0.5*SIGV/
(COLF1*HLIDM)
DWD:2*XZ
>
≤
DENZL=0.47*HLIDM
DENZL2=DENZL**2
FAC1=FAC3
FAC2=FAC3
|SINφ|:0.1
|SINΘ|:0.1
<
COMPUTE Z-ARGUMENTS
ARGZ1, ARGZ2 USING
SMALL-ANGLE
APPROXIMATION
≥
COMPUTE Z-ARGUMENTS
ARGZ1, ARGZ2 USING
GENERAL FORMULA
FAC1=EXP(ARGZ1)
FAC2=EXP(ARGZ2)
FAC1=FAC1+(DWD-XZ)*(FAC3-FAC1)/XZ
FAC2=FAC2+(DWD-XZ)*(FAC3-FAC2)/XZ
E


L
DLRS:(.01*DL)
<
≥
ISAC:1
NSUB:0
=
G
≠
NSUB:1
≥
I
<
CAVL = CBAR
N
RETURN

SUBROUTINE QMOD

Purpose:

To compute the linear distribution (in $(\text{Length})^{-1}$) of pollutant along runway due to aircraft emission during landing or takeoff.

Input:

YS1 ------- Distance along runway measured from the tip of exhaust plume near the starting end of runway.

TAIL ------ Length or penetration of the exhaust plume of aircraft at rest.

DL -------- Total length of the smoke slug on the runway.

A --------- Acceleration (or deceleration) of the aircraft.

V12 ------- Initial Velocity, V1, squared.

VS -------- Average velocity of the exhaust particles relative to the air mass in the tail or exhaust plume.

WS2 ------- Wind speed squared.

WSC ------- 2*(Wind Speed)*(-cosine of angle between runway and wind vector).

RR -------- A/G, where A is the acceleration of the aircraft and G is the normalization constant for line density.

Output:

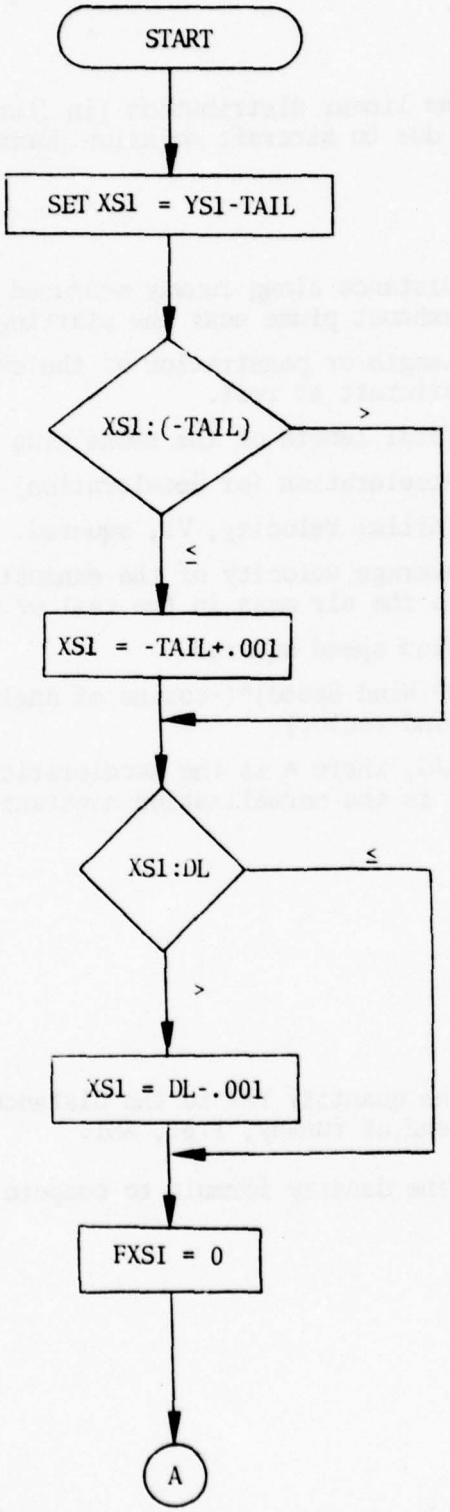
QL

Procedure:

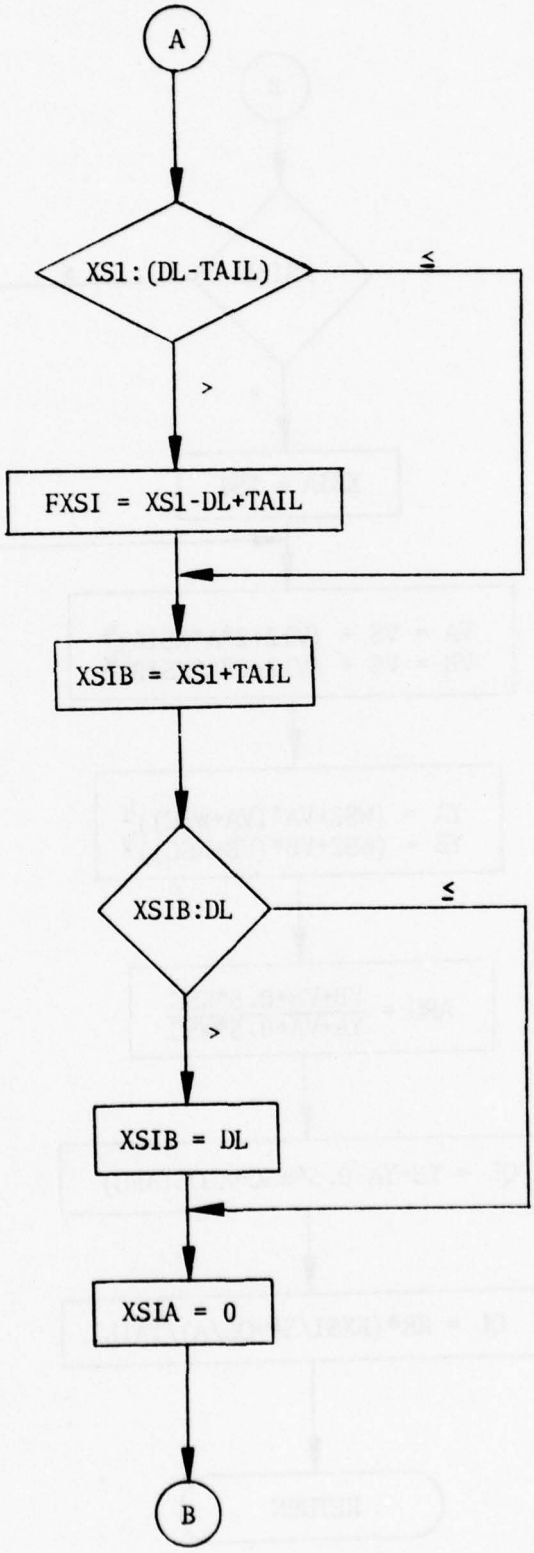
1. Convert the quantity YS1 to the distance measured from the physical end of runway, i.e., XS1.

2. Use the line density formula to compute QL(1/Length).

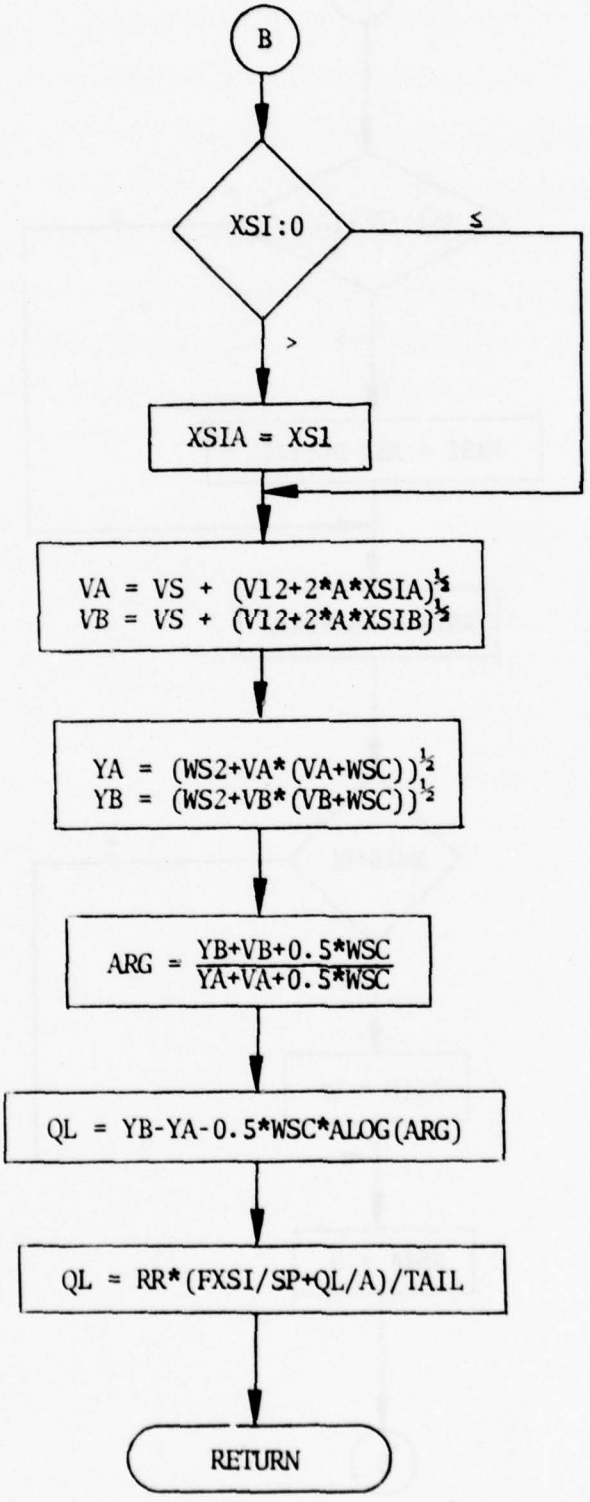
SUBROUTINE QMOD



SUBROUTINE QMOD (Continued)



SUBROUTINE QMOD (Continued)



FUNCTION TRAN

Purpose:

To compute the coupling coefficient at the receptor point due to a point or area source.

Input:

1. Meteorological parameters: wind speed; stability; mixing height; critical distance for mixing.

2. Source parameters: horizontal and vertical spreads; pseudo transport times corresponding to the horizontal and vertical spreads; area source flags: KSTAB, NRFLAG, and IBACK.

3. Receptor parameters: downwind and crosswind distances; receptor height.

Output:

Point or area source coupling coefficient: TRAN.

Procedure:

1. If the effective stack height exceeds the height of the sky lid, then stability index is reassigned according to the current hourly atmospheric stability and the source flag KSTAB computed in PLUME.

2. For point source and area source with source flag NRFLAG = 0, compute the travel time for z dispersion from the center and that for y dispersion from the downwind edge of the source.

3. For sources with NRFLAG = 0 the effects of ground and sky lid are treated by the image method. Up to 6 terms are included in the coupling coefficient.

4. For area source with NRFLAG = 1, the travel times from the downwind and upwind edges of the area sources are determined on the basis of receptor location relative to the area source. These plus the pseudo travel time T_z due to the Z-spread are used to compute the Z-dispersion coefficients $\sigma_z(T_1)$ and $\sigma_z(T_2)$.

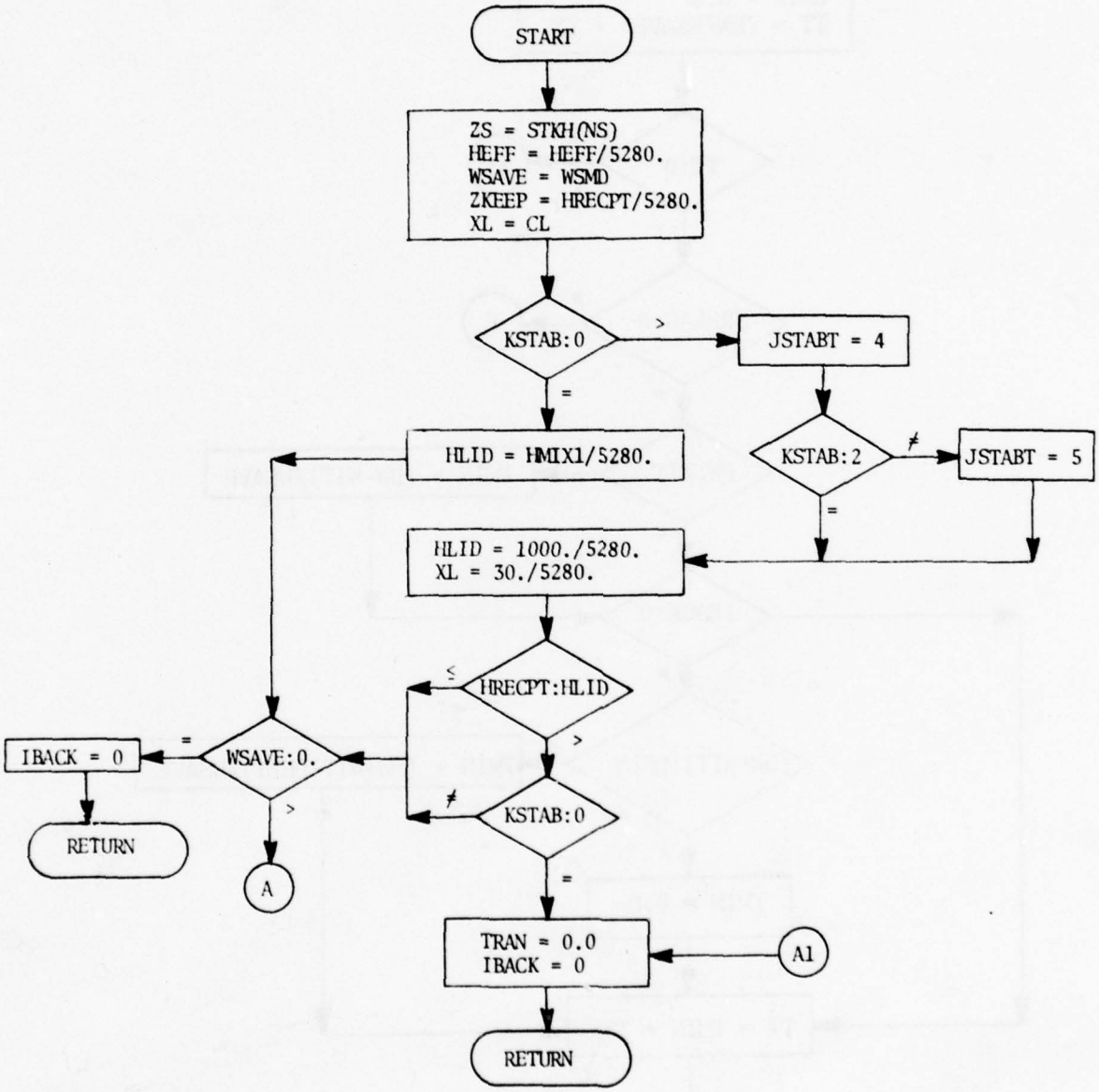
5. For area source with NRFLAG = 1, the y-dispersion coefficient $\sigma_y(TT)$ is determined on the basis of the pseudo travel time T_y due to the y-spread and the travel time from the downwind edge to the receptor.

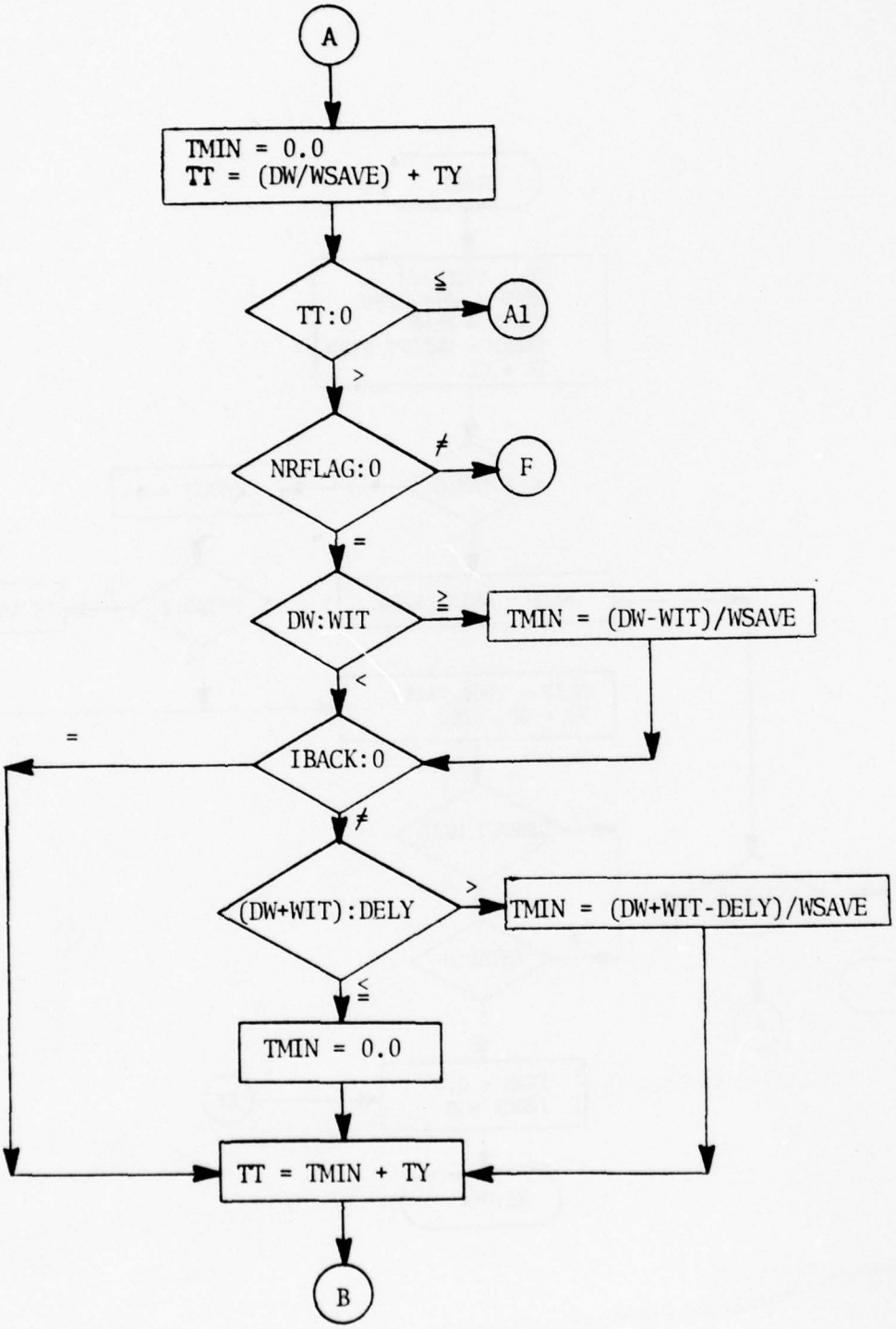
6. The coupling coefficient for area source with NRFLAG = 1 is then computed using the integrated expression for "near" source.

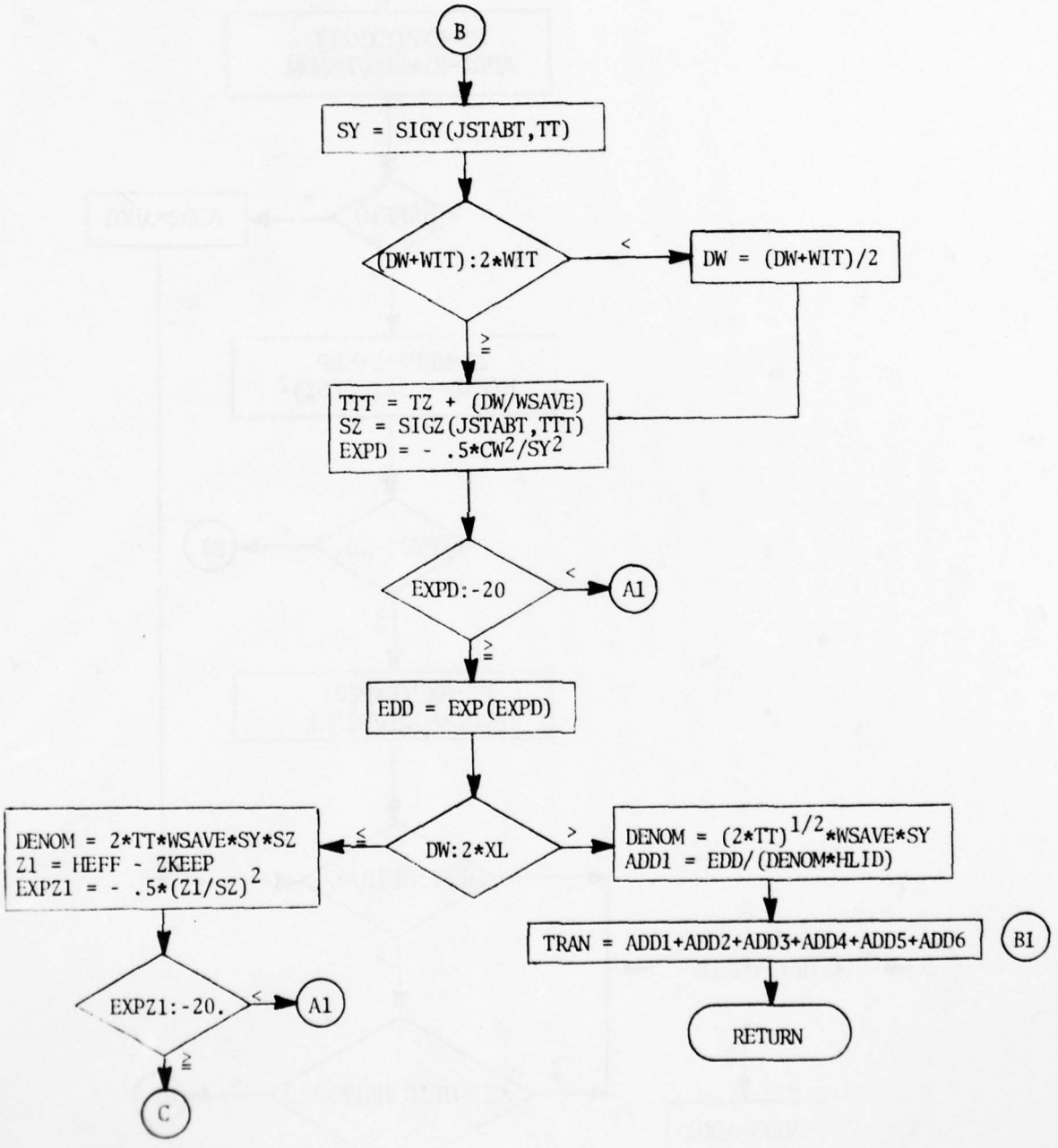
7. If the source flag IBACK is 1, part of the area source is to be treated as "near" and part as "far" area sources. When both contributions to the coupling coefficient are computed and summed, IBACK is then set to 0.

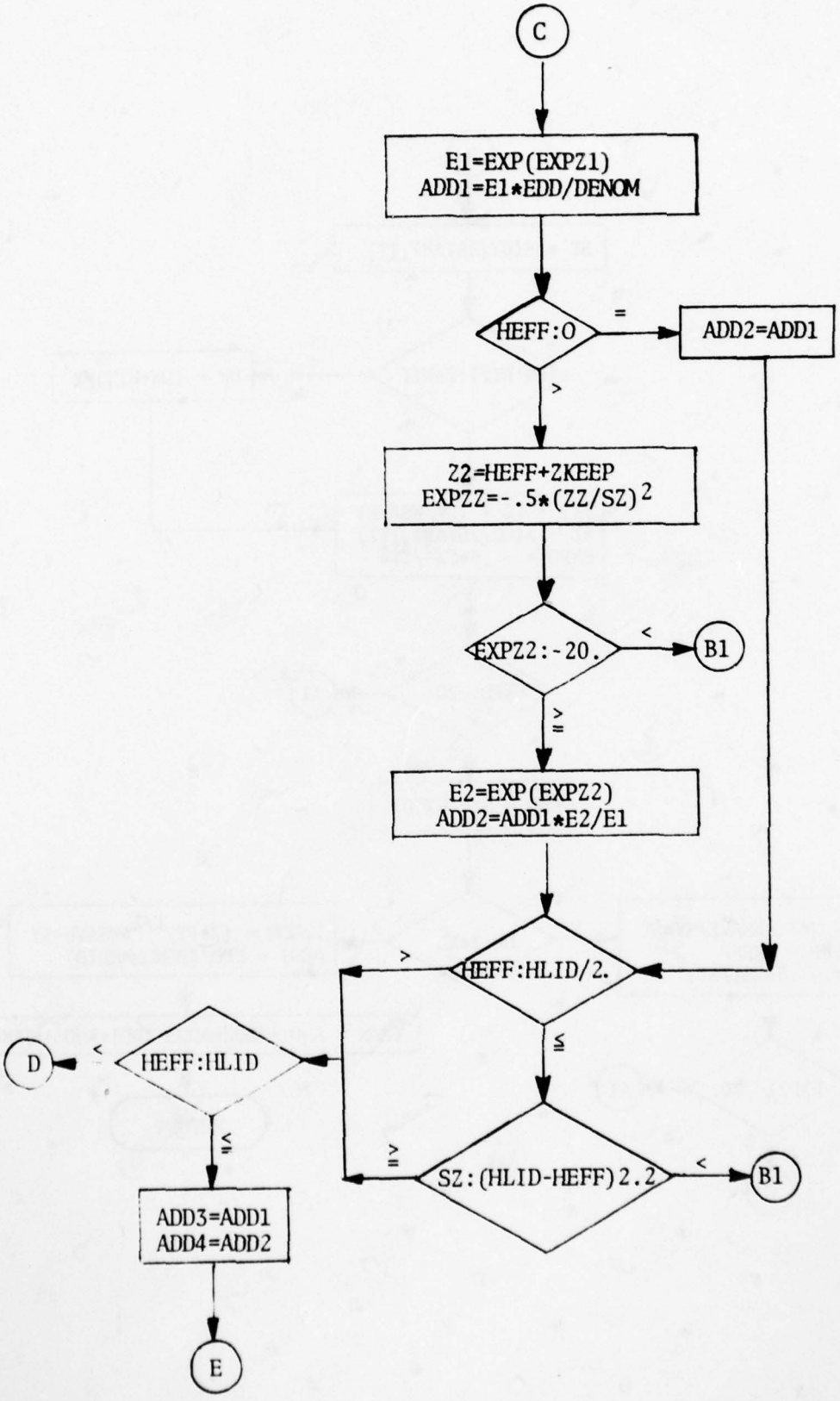
Functions Called:

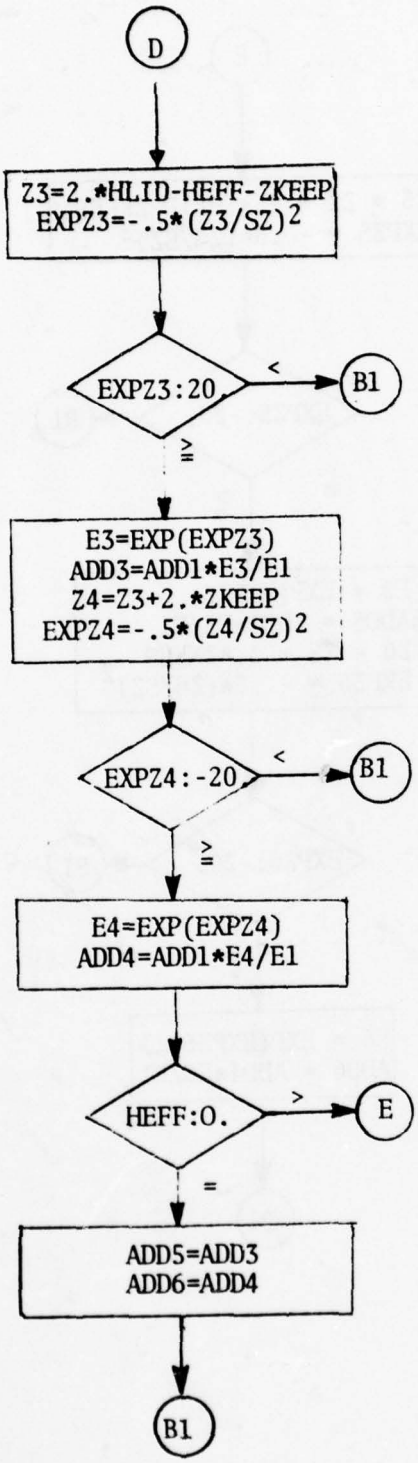
SIGY, SIGZ

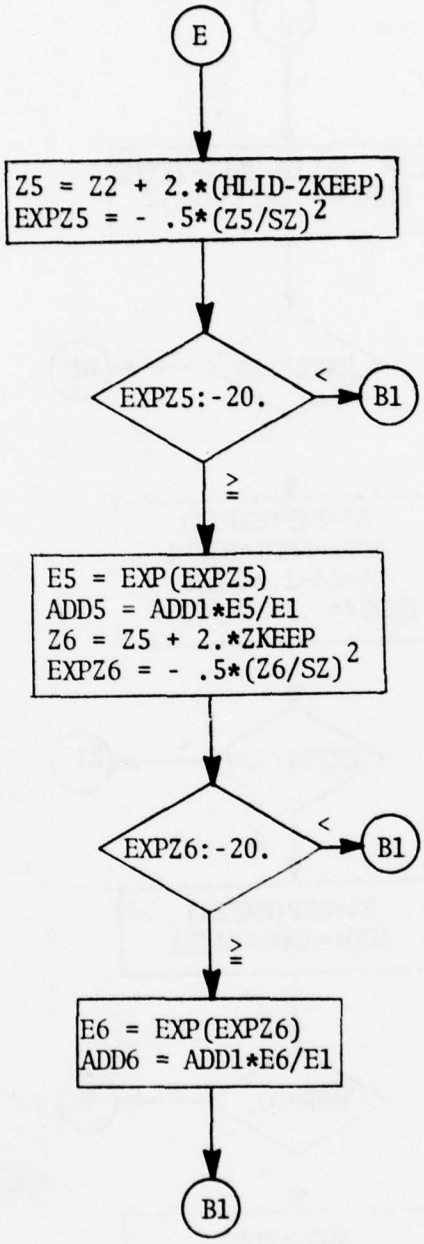

START
ZS = STKH(NS)
HEFF = HEFF/5280.
WSAVE = WSMD
ZKEEP = HRECPT/5280.
XL = CL
KSTAB:0
>
JSTABT = 4
=
KSTAB:2
≠
JSTABT = 5
=
HLID = HMIX1/5280.
HLID = 1000./5280.
XL = 30./5280.
≤
HRECPT:HLID
>
≠
KSTAB:0
=
WSAVE:0.
=
IBACK = 0
RETURN
>
A
TRAN = 0.0
IBACK = 0
A1
RETURN

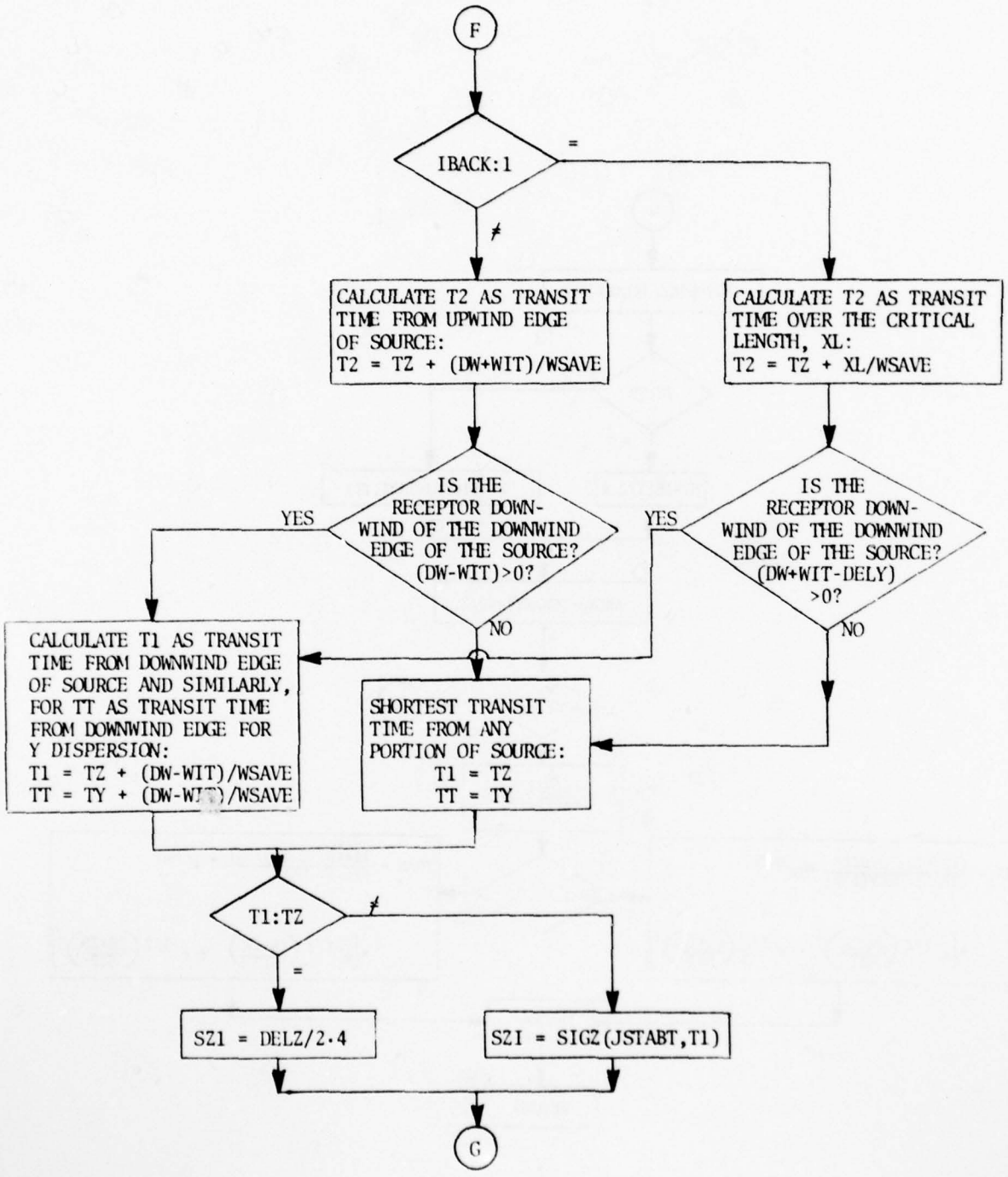

A
TMIN = 0.0
TT = (DW/WSAVE) + TY
TT:0
≦
A1
>
NRFLAG:0
≠
F
=
DW:WIT
≧
TMIN = (DW-WIT)/WSAVE
<
IBACK:0
=
≠
(DW+WIT):DELY
>
TMIN = (DW+WIT-DELY)/WSAVE
≦
TMIN = 0.0
TT = TMIN + TY
B

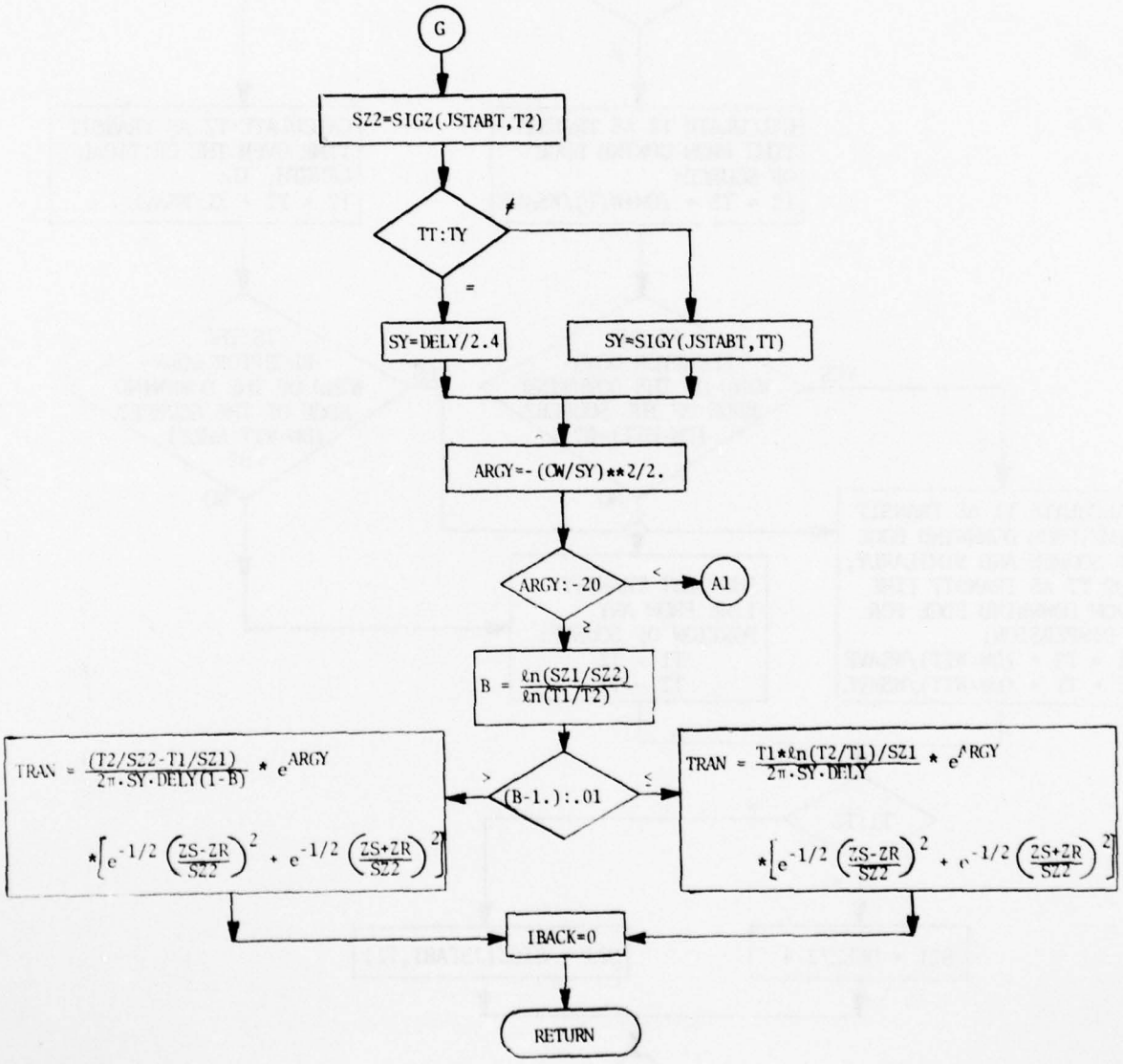

B
SY = SIGY(JSTABT,TT)
(DW+WIT):2*WIT
<
DW = (DW+WIT)/2
≥
TTT = TZ + (DW/WSAVE)
SZ = SIGZ(JSTABT,TTT)
EXPD = - .5*CW2/SY2
EXPD:-20
<
A1
≥
EDD = EXP(EXPD)
DW:2*XL
≤
DENOM = 2*TT*WSAVE*SY*SZ
Z1 = HEFF - ZKEEP
EXPZ1 = - .5*(Z1/SZ)2
>
DENOM = (2*TT)1/2*WSAVE*SY
ADD1 = EDD/(DENOM*HLID)
TRAN = ADD1+ADD2+ADD3+ADD4+ADD5+ADD6
BI
EXPZ1:-20.
<
A1
≥
C
RETURN


C
E1=EXP(EXPZ1)
ADD1=E1*EDD/DENOM
HEFF:0
=
ADD2=ADD1
>
ZZ=HEFF+ZKEEP
EXPZZ=-.5*(ZZ/SZ)2
EXPZ2:-20.
<
B1
≥
E2=EXP(EXPZ2)
ADD2=ADD1*E2/E1
>
HEFF:HLID/2.
≦
D
<
HEFF:HLID
≦
ADD3=ADD1
ADD4=ADD2
E
≥
SZ:(HLID-HEFF)2.2
<
B1


D
Z3=2.*HLID-HEFF-ZKEEP
EXPZ3=-.5*(Z3/SZ)2
EXPZ3:20.
<
B1
≥
E3=EXP(EXPZ3)
ADD3=ADD1*E3/E1
Z4=Z3+2.*ZKEEP
EXPZ4=-.5*(Z4/SZ)2
EXPZ4:-20.
<
B1
≥
E4=EXP(EXPZ4)
ADD4=ADD1*E4/E1
HEFF:0.
>
E
=
ADD5=ADD3
ADD6=ADD4
B1


E
Z5 = Z2 + 2.*(HLID-ZKEEP)
EXPZ5 = - .5*(Z5/SZ)**2
EXPZ5:-20.
<
B1
≥
E5 = EXP(EXPZ5)
ADD5 = ADD1*E5/E1
Z6 = Z5 + 2.*ZKEEP
EXPZ6 = - .5*(Z6/SZ)**2
EXPZ6:-20.
<
B1
≥
E6 = EXP(EXPZ6)
ADD6 = ADD1*E6/E1
B1


F
IBACK:1
=
≠
CALCULATE T2 AS TRANSIT TIME FROM UPWIND EDGE OF SOURCE: T2 = TZ + (DW+WIT)/WSAVE
CALCULATE T2 AS TRANSIT TIME OVER THE CRITICAL LENGTH, XL: T2 = TZ + XL/WSAVE
IS THE RECEPTOR DOWN-WIND OF THE DOWNWIND EDGE OF THE SOURCE? (DW-WIT)>0?
YES
NO
IS THE RECEPTOR DOWN-WIND OF THE DOWNWIND EDGE OF THE SOURCE? (DW+WIT-DELY) >0?
YES
NO
CALCULATE T1 AS TRANSIT TIME FROM DOWNWIND EDGE OF SOURCE AND SIMILARLY, FOR TT AS TRANSIT TIME FROM DOWNWIND EDGE FOR Y DISPERSION: T1 = TZ + (DW-WIT)/WSAVE TT = TY + (DW-WIT)/WSAVE
SHORTEST TRANSIT TIME FROM ANY PORTION OF SOURCE: T1 = TZ TT = TY
T1:TZ
≠
=
SZ1 = DELZ/2.4
SZ1 = SIGZ(JSTABT,T1)
G


G
SZ2=SIGZ(JSTABT,T2)
TT:TY
≠
=
SY=DELY/2.4
SY=SIGY(JSTABT,TT)
ARGY=-(CW/SY)**2/2.
ARGY:-20
<
A1
≥
B = ln(SZ1/SZ2) / ln(T1/T2)
(B-1.):.01
>
≤
TRAN = (T2/SZ2-T1/SZ1) / 2π·SY·DELY(1-B) * e^ARGY
*[e^-1/2 ((ZS-ZR)/SZ2)^2 + e^-1/2 ((ZS+ZR)/SZ2)^2]
TRAN = T1*ln(T2/T1)/SZ1 / 2π·SY·DELY * e^ARGY
*[e^-1/2 ((ZS-ZR)/SZ2)^2 + e^-1/2 ((ZS+ZR)/SZ2)^2]
IBACK=0
RETURN

APPENDIX C

FORTRAN LISTING OF THE AVAP MODEL ABBREVIATED VERSION

```
C...  AVAP MAIN PGM                                                    00000001
      REAL*4 TITLE1(20),TITLE(10)                                      00000002
      REAL*4 NAME(10)                                                  00000003
      REAL*8 SRNAME(14),NAUT(5)                                        00000004
      INTEGER OUTPUT,DFAULT(23)                                        00000005
      DIMENSION EMIT(5,2)                                              00000006
      DIMENSION IKA(10),IKB(10)                                        00000007
      DIMENSION SDY(2)                                                 00000008
C     EMIT CONTAINS FIVE POLLUTANT EMISSION RATES FOR TWO AREA SOURCES 00000009
      DIMENSION XRECP(20),YRECP(20),ZRECP(20),NRUSED(20)               00000010
      DIMENSION CON(10)                                                00000011
      DIMENSION XA(7),YA(7),ZA(7),XB(7),YB(7),ZB(7)                    00000012
      DIMENSION RTXY(2),EMLN(5),EMTF(5)                                00000013
      DIMENSION CCUP(20),TERM(5),EMTXI(5 ),EMTXO(5 ),                  00000014
     - RWIDL(5,2),EMID(5),EAPU(5)                                      00000015
      DIMENSION ALSC(60,6)                                             00000016
      DIMENSION ALSE(60,6)                                             00000017
      DIMENSION PLLTNT(5),SRVHR(14)                                    00000018
      DIMENSION CWS(2),DWS(2),CWR(20),DWR(20),RECDAT(4,5,20)           00000019
      DIMENSION HEFF(5),KSTAB(5)                                       00000020
      COMMON/DEFLT/NAC(10),FLNDG(10),FTKOF(10),NGIN(10),INGN(10),      00000021
     1EMI(5,4,5),DSRW,HRW, FTAXI(10),                                  00000022
     2FTXII(10),FTXIO(10),DSTW,HTW,DSRA,HRA,FFUH(5),FFUL(5),DSAR,HAR,  00000023
     3SRVTIM(10,14),KAPU(10),APU(5),FIDLE(10),TGND(10),DFAULT          00000024
      COMMON/DELTA/DELY,DELZ                                           00000025
      COMMON/FUEL/FFD(5),EFG(5)                                        00000026
      COMMON/LN/DL,XW1,YW1,ZW1,XW2,YW2,ZW2,COEF1,COEF2,VA1,VA2,VD1,VD2, 00000027
     -C,TIME,VA12,VA22,VD12,VD22,WS2,WSC,JAD,SNAN,CSAN,V1,V2,V12,V22,   00000028
     -TAIL,VS,RR,SP                                                    00000029
      COMMON/LN1/IACC                                                  00000030
      COMMON/LOC/DW,CW                                                 00000031
      COMMON/MET/WS,WD,JSTAB,HLID,TEMP,XL,SUDOY,SUDOZ                  00000032
      COMMON/PL4/XS(5),YS(5),STKH(5),WIT(5)                            00000033
      COMMON/POL/NPT,IJ(5)                                             00000034
      COMMON/RECPT/HRECPT,HTAERO,ZRECPG                                00000035
      COMMON/RISE/ZSS                                                  00000036
      COMMON/SEUDO/TXT,TYT,TZT                                         00000037
      COMMON/SERVHL/SRNAME                                             00000038
      COMMON/XTRAN/WSMD,NCALM,SQTOPI                                   00000039
      DATA NAME/'CO  ','THC ','NOX ','PART','SOX ',5*'    '/           00000040
      DATA NAUT/'CO(PPM) ','THC(PPM)','NOX(PPM)','PT(M/CM)','SO2(PPM)'/00000041
      DATA BLANK/'    '/                                               00000042
      DATA SQ2PI /2.5066283  /                                         00000043
C     CONVF CONVERTS LBS/MI**3 INTO MICRO GM/M**3                      00000044
      DATA CONVF/.10882139/                                            00000045
      DATA CON/1250.,666.,2054.,1.,2854.,5*1./                         00000046
      INPUT = 5                                                        00000047
      OUTPUT = 6                                                       00000048
      READ(INPUT,17) TITLE1                                            00000049
      READ(INPUT,19) (TITLE(I),I=1,10)                                 00000050
      WRITE(OUTPUT,17) TITLE1                                          00000051
      WRITE(OUTPUT,31)(TITLE(I),I=1,10)                                00000052
   17 FORMAT(20A4)                                                     00000053
```

```
   14 FORMAT(10A4)                                                    00000054
C..  SCAN THE POLLUTANT SPECIFICATION CARD.                           00000055
      NPT = 0                                                         00000056
      I = 1                                                           00000057
      L = 1                                                           00000058
      IFLAG = 1                                                       00000059
  500 IF(NAME(I).EQ.TITLE(L)) GO TO 502                               00000060
  505 L = L+1                                                         00000061
      IF(L.LE.10) GO TO 500                                           00000062
      I = I+1                                                         00000063
      IF(I.GT.10) GO TO 501                                           00000064
      L = 1                                                           00000065
      GO TO 500                                                       00000066
  501 IF(IFLAG.EQ.1) GO TO 503                                        00000067
      GO TO 504                                                       00000068
  502 IF(TITLE(L).EQ.BLANK) GO TO 505                                 00000069
      NPT = NPT+1                                                     00000070
      IFLAG = 0                                                       00000071
  506 IJ(NPT) = I                                                     00000072
      IF(NPT.EQ.1) GO TO 510                                          00000073
      IF(IJ(NPT).EQ.IJ(NPT-1)) GO TO 507                              00000074
  510 CONTINUE                                                        00000075
      IF(I.LT.10) GO TO 505                                           00000076
      GO TO 504                                                       00000077
  503 WRITE(OUTPUT,508) (TITLE(I),I=1,10)                             00000078
  508 FORMAT(1H1,'   ERROR----POLLUTANT NAME NOT FOUND      ',10A4)   00000079
      GO TO 504                                                       00000080
  507 WRITE(OUTPUT,509) TITLE(L)                                      00000081
  509 FORMAT(1H1,'   DUPLICATE POLLUTANT REQUEST     ',A4)            00000082
      NPT = NPT-1                                                     00000083
      GO TO 506                                                       00000084
  504 CONTINUE                                                        00000085
      MTXI = 2                                                        00000086
      MSVR = 14                                                       00000087
      NFWY = 1                                                        00000088
      NAPS = 2                                                        00000089
C..   READ HEIGHT OF AEROVANE FOR WIND MEASUREMENT                    00000090
      READ(INPUT,4713) HTAERO,WSP,DIR,TEMP,JSTAB,NLID,NMONTH,NP       00000091
 4713 FORMAT(4F8.0,2I8,2I2)                                           00000092
      READ(INPUT,12) NSR,NACT,NENT,NAVP,NACA,NANA                     00000093
C.. SELECT DEFAULT OPTIONS.                                           00000094
C                                                                     00000095
      READ(INPUT,1)(DEFAULT(I),I=1,23)                                00000096
C                                                                     00000097
C..   READ RECEPTOR COORDINATES X,Y, IN MILES, Z IN FEET.             00000098
      READ(INPUT,4711)(NRUSED(N),XRECP(N),YRECP(N),ZRECP(N),N=1,NSR)  00000099
      DO 2263 K1=1,4                                                  00000100
      DO 2263 LL = 1,NPT                                              00000101
      K2 = IJ(LL)                                                     00000102
      DO 2263 K3=1,NSR                                                00000103
 2263 RECDAT(K1,K2,K3)=0.0                                            00000104
      TEM = TEMP                                                      00000105
      WD = DIR                                                        00000106
      US = WSP*1.15                                                   00000107
      JSTABF = JSTAB                                                  00000108
```

```
C..  FUNCTION HMIX WILL RETURN A VALUE FOR MIXING DEPTH                    00000109
      HLID = NLID*10                                                       00000110
      IF(HLID.EQ.0.0) HLID=HMIX(JSTABB,NMONTH,NR,WS)                       00000111
      WRITE(OUTPUT,34) NSR,NRWY,NTXI,NAPR,NACA,NACT,NENT,NSVR,NAVR,NANA    00000112
      WRITE(OUTPUT,9711) NSR,(XRECP(N),YRECP(N),ZRECP(N),N=1,NSR)          00000113
      WRITE(OUTPUT,9744)(NRUSED(N),N=1,NSR)                                00000114
      WRITE(OUTPUT,9734) HTAERO,WS,DIR,TEMP,JSTAB,HLID                     00000115
C..  COMPUTE SINE AND COSINE OF THE WIND ANGLE                             00000116
      WDRAD=WD*.01745                                                      00000117
      SINWD=SIN(WDRAD)                                                     00000118
      COSWD=COS(WDRAD)                                                     00000119
      A=WS*SINWD                                                           00000120
      B=WS*COSWD                                                           00000121
      HL=HLID*0.47/5280.                                                   00000122
      DS=0.                                                                00000123
      KL=2                                                                 00000124
      TX=0.                                                                00000125
      TY=0.                                                                00000126
      TZ=0.                                                                00000127
      CALL PSEUDO(DS,A,B,TX,TY,TZ,DX,DY,JSTAB,HL,KL)                       00000128
      XL=WS*TZ                                                             00000129
      WS2 = WS*WS                                                          00000130
      WAN = 270.-WD                                                        00000131
      WAN = WAN*3.1415927/180.                                             00000132
      CSAN = COS(WAN)                                                      00000133
      SNAN= SIN(WAN)                                                       00000134
C..  INPUT AIRCRAFT ARRIVAL AND DEPARTURE ACTIVITY BY TYPE .               00000135
C..                                                                        00000136
      IF(DFAULT(1).NE.0)                                                   00000137
     1READ(INPUT,5)(NAC(I),I=1,NACT)                                       00000138
      WRITE(OUTPUT,580) NACT,(NAC(K),K=1,NACT)                             00000139
  580 FORMAT(1X,'ARRIVAL ACTIVITY FOR AIRCRAFT TYPES 1 THROUGH',I3         00000140
     -,3X,10I3)                                                            00000141
C..                                                                        00000142
C.. INPUT TIME(HOUR) SPENT IN LANDING MODE.                                00000143
C..                                                                        00000144
      IF(DFAULT(2).NE.0)                                                   00000145
     1READ(INPUT,25)(FLNDG(I),I=1,NACT)                                    00000146
      WRITE(OUTPUT,597)(FLNDG(I),I=1,NACT)                                 00000147
C..                                                                        00000148
C.. INPUT TIME(HOUR) SPENT IN TAKE-OFF MODE.                               00000149
C..                                                                        00000150
      IF(DFAULT(3).NE.0)                                                   00000151
     1READ(INPUT,25)(FTKOF(I),I=1,NACT)                                    00000152
      WRITE(OUTPUT,598)(FTKOF(I),I=1,NACT)                                 00000153
C..                                                                        00000154
C.. INPUT THE NUMBER OF ENGINES USED WITH EACH AIRCRAFT TYPE.              00000155
C..                                                                        00000156
      IF(DFAULT(4).NE.0)                                                   00000157
     1READ(INPUT,5)(NGIN(I),I=1,NACT)                                      00000158
C..                                                                        00000159
C.. INPUT THE ENGINE TYPE INDEX OF THE ABOVE ENGINES.                      00000160
C..                                                                        00000161
      IF(DFAULT(5).NE.0)                                                   00000162
     1READ(INPUT,5)(INGN(I),I=1,NACT)                                      00000163
```

```
C..                                                                    00000164
C.. INPUT FOR THE SPECIFIED POLLUTANT(S), THE EMISSION RATE(LB/HR)     00000165
C.. OF EACH AIRCRAFT ENGINE TYPE FOR THE FOLLOWING FOUR (4) MODES      00000166
C.. OF OPERATION: 1. TAXI, 2. IDLE, 3. LANDING, 4. TAKE-OFF.          00000167
      IF(DFAULT(6).EQ.0) GO TO 446                                     00000168
C..                                                                    00000169
      DO 445 I=1,NENT                                                  00000170
      DO 445 J=1,4                                                     00000171
  445 READ(INPUT,3)(EMI(I,J,IJ(K)),K=1,NPT)                            00000172
  446 CONTINUE                                                         00000173
      I5 = 5                                                           00000174
C                                                                      00000175
      IF(DFAULT(6).EQ.0) GO TO 447                                     00000176
      I5 = NENT                                                        00000177
C                                                                      00000178
  447 DO 448 I = 1,I5                                                  00000179
      DO 448 J = 1,4                                                   00000180
      WRITE(OUTPUT,150)(J,(EMI(I,J,IJ(K)),K=1,NPT))                    00000181
  448 CONTINUE                                                         00000182
C..                                                                    00000183
C.. INPUT INITIAL DIMENSIONS OF RUNWAY WIDTH AND HEIGHT.               00000184
C..                                                                    00000185
      IF(DFAULT(7).NE.0)                                               00000186
     1READ(INPUT,323) DSRW,HRW                                         00000187
      DSRW = DSRW/2.4                                                  00000188
      HRW = HRW/1.2                                                    00000189
      KL = 0                                                           00000190
      CALL PSEUDO(DSRW,A,B,TX1,TY1,TZ1,DX,DY,JSTAB,HRW,KL)             00000191
      SUBY = WS * TX1                                                  00000192
      SUBZ = WS * TZ1                                                  00000193
C.. INPUT RUNWAY COORDINATES.                                          00000194
C..                                                                    00000195
      READ(INPUT,1244) X1,Y1,Z1,X2,Y2,Z2                               00000196
      WRITE(OUTPUT,9715) X1,Y1,Z1,X2,Y2,Z2                             00000197
      Z1 = Z1/5280.                                                    00000198
      Z2 = Z2/5280.                                                    00000199
      RUNX = X2                                                        00000200
      RUNY = Y2                                                        00000201
C..                                                                    00000202
C.. INPUT RUNWAY PARAMETERS: INITIAL AND FINAL VELOCITIES DURING       00000203
C.. ARRIVAL AND DEPARTURE, TAKE-OFF ROLL TIME, AND EXHAUST TAIL LENGTH. 00000204
C.. THESE VALUES WILL DEFAULT AS FOLLOWS*                              00000205
C..       VA1 = RUNWAY-ARRIVAL INITIAL VELOCITY = 145 MILES/HOUR.      00000206
C..       VA2 = RUNWAY-ARRIVAL FINAL VELOCITY   =  25 MILES/HOUR.      00000207
C..       VD1 = RUNWAY-DEPARTURE INITIAL VELOCITY=   0 MILES/HOUR.     00000208
C..       VD2 = RUNWAY-DEPARTURE FINAL VELOCITY = 180 MILES/HOUR.      00000209
C..      TIME = TAKE-OFF ROLL TIME              = .01111 HOURS.       00000210
C..      TAIL = EXAUST TAIL LENGTH              = .8523  MILES.       00000211
C..                                                                    00000212
      IF(DFAULT(8).NE.0)                                               00000213
     1READ(INPUT,1244) VA1,VA2,VD1,VD2,TIME,TAIL                       00000214
      WRITE(OUTPUT,9721) VA1,VA2,VD1,VD2,TIME,TAIL                     00000215
      IF(TAIL.LE.0) TAIL = 20./5280.                                   00000216
      VA12 = VA1*VA1                                                   00000217
      VA22 = VA2*VA2                                                   00000218
```

```
      VD12 = VD1*VD1                                                    00000219
      VD22 = VD2*VD2                                                    00000220
C                                                                       00000221
C                              COMPUTE RUNWAY EMISSIONS                 00000222
C                                                                       00000223
      DO 42 L = 1,NPT                                                   00000224
      J = IJ(L)                                                         00000225
      EMLN(J) = 0.0                                                     00000226
      EMTF(J) = 0.0                                                     00000227
      TERM(J) = 0.0                                                     00000228
      EMTXI(J ) = 0.0                                                   00000229
      EMTXO(J ) = 0.0                                                   00000230
      EMID(J) = 0.0                                                     00000231
      EAPU(J) = 0.0                                                     00000232
      DO 42 K = 1,NACT                                                  00000233
      TNENG = NAC(K) * NGIN(K)                                          00000234
      EMLN(J) = TNENG*FLNDG(K)*EMI(INGN(K),3,J) + EMLN(J)               00000235
   42 EMTF(J) = TNENG*FTKOF(K)*EMI(INGN(K),4,J) + EMTF(J)               00000236
C                                                                       00000237
      DO 8412 IACC = 1,2                                                00000238
      DO 821 M = 1,NSR                                                  00000239
      ZR = ZRECP(M)/5280.                                               00000240
      CALL LINE(XRECP(M),YRECP(M),ZR,X1,Y1,Z1,X2,Y2,Z2,CUP)             00000241
 5901 FORMAT(1HO,I1,1X,13(E9.3,1X))                                     00000242
      COUPP = CUP*CONVF/WS                                              00000243
      DO  821 LL = 1,NPT                                                00000244
      J = IJ(LL)                                                        00000245
      EMSL = EMLN(J)                                                    00000246
      IF(IACC.EQ.2) EMSL = EMTF(J)                                      00000247
      RECDAT(3,J,M) = RECDAT(3,J,M) + COUPP*EMSL                        00000248
      RECDAT(4,J,M) = RECDAT(4,J,M) + COUPP*EMSL                        00000249
  821 CONTINUE                                                          00000250
 8412 CONTINUE                                                          00000251
C                                                                       00000252
C                              TAXIWAYS AS LINE SOURCES.                00000253
C                                                                       00000254
C.. INPUT AIRCRAFT TAXI SPEEDS(MI/HR) IN THE TERMINAL AREA, ON THE      00000255
C.. INBOUND TAXIWAY, AND ON THE OUTBOUND TAXIWAY RESPECTIVILY.          00000256
      IF(DFAULT(9).NE.0)                                                00000257
     1READ(INPUT,25)(FTAXI(I),I=1,NACT)                                 00000258
      IF(DFAULT(10).NE.0)                                               00000259
     1READ(INPUT,25)(FTXII(I),I=1,NACT)                                 00000260
      IF(DFAULT(11).NE.0)                                               00000261
     1READ(INPUT,25)(FTXIO(I),I=1,NACT)                                 00000262
      WRITE(OUTPUT,592)(FTAXI(I),I=1,NACT)                              00000263
      WRITE(OUTPUT,593)(FTXII(I),I=1,NACT)                              00000264
      WRITE(OUTPUT,594)(FTXIO(I),I=1,NACT)                              00000265
C                                                                       00000266
C.. INPUT INITIAL DIMENSIONS OF TAXIWAY WIDTH AND HEIGHT.               00000267
C                                                                       00000268
      IF(DFAULT(12).NE.0)                                               00000269
     1READ(INPUT,323) DSTW,HTW                                          00000270
      DSTW = DSTW/2.4                                                   00000271
      HTW = HTW/1.2                                                     00000272
      KL = 0                                                            00000273
```

```
      CALL PSEUDO(DSTW,A,B,TX2,TY2,TZ2,DX,DY,JSTAB,HTW,KL)                00000274
      SUDDY = WS*TX2                                                      00000275
      SUDDZ = WS*TZ2                                                      00000276
      IADC = 0                                                            00000277
      DO 826 ITX = 1,NTXI                                                 00000278
C.. INPUT TAXIWAY LINE COORDINATES.                                       00000279
C                                                                         00000280
      READ(INPUT,1244) X1,Y1,Z1,X2,Y2,Z2                                  00000281
      WRITE(OUTPUT,9716) X1,Y1,Z1,X2,Y2,Z2                                00000282
      Z1 = Z1/5280.                                                       00000283
      Z2 = Z2/5280.                                                       00000284
      XXSQ = (X1-X2)**2                                                   00000285
      YYSQ = (Y1-Y2)**2                                                   00000286
      DTXL = SQRT(XXSQ+YYSQ)                                              00000287
C                                                                         00000288
      EMTAXI = 0.0                                                        00000289
C                                                                         00000290
C                     COMPUTE TAXI EMISSIONS                              00000291
C                                                                         00000292
      DO 8413 LL = 1,NPT                                                  00000293
      J = IJ(LL)                                                          00000294
      DO 41 K = 1,NACT                                                    00000295
      TNENG = NAC(K) * NGIN(K)                                            00000296
      EMTX = TNENG * EMI(INGN(K),1,J)                                     00000297
C...                                                                      00000298
C                                                                         00000299
      PTI = 1/FTXII(K)                                                    00000300
      PTO = 1/FTXIO(K)                                                    00000301
      EMTXII = EMTX*DTXL                                                  00000302
      IF(ITX.EQ.1) EMTXI(J) = EMTXII*PTI + EMTXI(J)                       00000303
      IF(ITX.EQ.2) EMTXO(J) = EMTXII*PTO + EMTXO(J)                       00000304
   41 CONTINUE                                                            00000305
      DO 8413 M = 1,NSR                                                   00000306
      ZR = ZRECP(M)/5280.                                                 00000307
      CALL LINE(XRECP(M),YRECP(M),ZR,X1,Y1,Z1,X2,Y2,Z2,CUP)              00000308
      COUPP = CUP*CONVF/WS                                                00000309
      IF(ITX.EQ.1) EMTAXI = EMTXI(J)                                      00000310
      IF(ITX.EQ.2) EMTAXI = EMTXO(J)                                      00000311
      RECDAT(3,J,M) = RECDAT(3,J,M) + COUPP *EMTAXI                       00000312
      RECDAT(4,J,M) = RECDAT(4,J,M) + COUPP *EMTAXI                       00000313
 8413 CONTINUE                                                            00000314
  826 CONTINUE                                                            00000315
C                                                                         00000316
C        OUTBOUND APRON QUEUING AS LINE SOURCES                           00000317
C                                                                         00000318
C.. INPUT INITIAL DIMENSIONS OF APRON WIDTH AND HEIGHT.                   00000319
C                                                                         00000320
      IF(DEFAULT(13).NE.0)                                                00000321
     1READ(INPUT,323) DSRA,HRA                                            00000322
      WRITE(OUTPUT,9719) DSRW,HRW,DSTW,HTW,DSRA,HRA                       00000323
      DSRA = DSRA/2.4                                                     00000324
      HRA = HRA/1.2                                                       00000325
      KL = 0                                                              00000326
      CALL PSEUDO(DSRA,A,B,TX3,TY3,TZ3,DX,DY,JSTAB,HRA,KL)                00000327
      SUDDY = WS*TX3                                                      00000328
```

```
      SUDDZ = WS*TZ3                                                    00000329
      EACT1 = 0.0                                                       00000330
      EACT2 = 0.0                                                       00000331
      IADC = 0                                                          00000332
      DO 43 I = 1,NACT                                                  00000333
      EFACT = NAC(I)                                                    00000334
      IKA(I) = .5*EFACT+.5                                              00000335
      IKB(I) = EFACT-IKA(I)                                             00000336
      EACT1 = EACT1 + IKA(I)                                            00000337
   43 EACT2 = EACT2 + IKB(I)                                            00000338
      RCT1 = (EACT1/180. + 1./60.)                                      00000339
      RCT2 = (EACT2/180. + 1./60.)                                      00000340
C..                                                                     00000341
C.. INPUT AIRPORT APRON COORDINATES.                                    00000342
C                                                                       00000343
      READ(INPUT,1244)(XA(N),YA(N),ZA(N),XB(N),YB(N),ZB(N),N=1,2)       00000344
      DO 124 N=1,2                                                      00000345
      SQXY =(XA(N)-XB(N))**2 + (YA(N)-YB(N))**2                         00000346
      RTXY(N) = SQRT(SQXY)                                              00000347
      ZA(N) = ZA(N)/5280.                                               00000348
      ZB(N) = ZB(N)/5280.                                               00000349
  124 CONTINUE                                                          00000350
C                                                                       00000351
      DO 827 L=1,2                                                      00000352
      DISP = 300./5280.                                                 00000353
      SN1 = 1.                                                          00000354
      SN2 = 1.                                                          00000355
      X1 = XA(L)                                                        00000356
      Y1 = YA(L)                                                        00000357
      Z1 = ZA(L)                                                        00000358
      X2 = XB(L)                                                        00000359
      Y2 = YB(L)                                                        00000360
      Z2 = ZB(L)                                                        00000361
      WRITE(OUTPUT,9717) X1,Y1,Z1,X2,Y2,Z2                              00000362
      IF(L.EQ.1) GO TO 820                                              00000363
      CSI = DISP*(YB(L)-YA(L))/RTXY(L)                                  00000364
      ETA = DISP*(XB(L)-XA(L))/RTXY(L)                                  00000365
      CSI = ABS(CSI)                                                    00000366
      ETA = ABS(ETA)                                                    00000367
      XC = XB(L)-RUNX                                                   00000368
      YC = YB(L)-RUNY                                                   00000369
      IF(XC.NE.0) SN1 = XC/ABS(XC)                                      00000370
      IF(YC.NE.0) SN2 = YC/ABS(YC)                                      00000371
      X1 = X1 + SN1*CSI                                                 00000372
      Y1 = Y1 + SN2*ETA                                                 00000373
      X2 = X2 + SN1*CSI                                                 00000374
      Y2 = Y2 + SN2*ETA                                                 00000375
  820 CONTINUE                                                          00000376
      DO 823 M=1,NSR                                                    00000377
      CCUP(M) = 0.0                                                     00000378
      ZR = ZRECP(M)/5280.                                               00000379
      CALL LINE(XRECP(M),YRECP(M),ZR,X1,Y1,Z1,X2,Y2,Z2,CUP)             00000380
      CCUP(M) = CUP*CONVF/WS                                            00000381
  823 CONTINUE                                                          00000382
C                                                                       00000383
```

```
      DO 8414 LL=1,NPT                                                    00000384
      J = IJ(LL)                                                          00000385
      RWIDL(J,L) = 0.0                                                    00000386
      DO 44 K =1,NACT                                                     00000387
      IF(L.EQ.1)                                                          00000388
     1 EMRIDL = NAC(K) * NGIN(K) * EMI(INGN(K),1,J) * PTXY(L)/FTXII(K)    00000389
      ROT = (IKA(K)*ROT1 + IKB(K)*ROT2)                                   00000390
      IF(L.EQ.2)EMRIDL  =   NGIN(K) * EMI(INGN(K),2,J) * ROT              00000391
   44 RWIDL(J,L) = EMRIDL   + RWIDL(J,L)                                  00000392
C                                                                         00000393
      DO 8414 M=1,NSR                                                     00000394
      RECDAT(3,J,M) = RECDAT(3,J,M) + COUP(M)*RWIDL(J,L)                  00000395
      RECDAT(4,J,M) = RECDAT(4,J,M) + COUP(M)*RWIDL(J,L)                  00000396
 8414 CONTINUE                                                            00000397
  827 CONTINUE                                                            00000398
C                                                                         00000399
C                    ACCESS VEHICLE ROADWAYS AS LINE SOURCES              00000400
C                                                                         00000401
      IF(NAVR.EQ.0) GO TO 301                                             00000402
C.. INPUT AUTOMOBILE EMISSION FACTORS(GM/KM)                              00000403
C                                                                         00000404
      IF(DEFAULT(14).NE.0)                                                00000405
     1READ(INPUT,3)(EFUH(IJ(I)),I=1,NPT)                                  00000406
      IF(DEFAULT(15).NE.0)                                                00000407
     1READ(INPUT,3)(EFUL(IJ(I)),I=1,NPT)                                  00000408
      WRITE(OUTPUT,773)(EFUH(IJ(I)),I=1,NPT)                              00000409
      WRITE(OUTPUT,774)(EFUL(IJ(I)),I=1,NPT)                              00000410
C                                                                         00000411
C.. INPUT INITIAL DIMENSIONS OF ROADWAY WIDTH AND HEIGHT.                 00000412
      IF(DEFAULT(16).NE.0)                                                00000413
     1READ(INPUT,323) DSAR,HAR                                            00000414
      DSAR = DSAR/2.4                                                     00000415
      HAR = HAR/1.2                                                       00000416
      KL = 0                                                              00000417
      CALL PSEUDO(DSAR,A,B,TXA,TYA,TZA,DX,DY,JSTAB,HAR,KL)                00000418
      SLOPY = WS * TXA                                                    00000419
      SLOPZ = WS * TZA                                                    00000420
C                                                                         00000421
C.. INPUT ACCESS VEHICLE ROADWAY COORDINATES.                             00000422
C                                                                         00000423
      WRITE(OUTPUT,9735)                                                  00000424
      DO 826 N=1,NAVR                                                     00000425
      READ(INPUT,311)  X1,Y1,Z1,X2,Y2,Z2,VNOCN,IFS                        00000426
      WRITE(OUTPUT,9725) X1,Y1,Z1,X2,Y2,Z2,VNOCN,IFS                      00000427
      Z1 = Z1/5280.                                                       00000428
      Z2 = Z2/5280.                                                       00000429
      XSQ = (X1-X2)**2                                                    00000430
      YSQ = (Y1-Y2)**2                                                    00000431
      CVL = SQRT(XSQ+YSQ)                                                 00000432
      IASC = 0                                                            00000433
C                                                                         00000434
      DO 824 M=1,NSR                                                      00000435
      ZR = ZRECP(M)/5280.                                                 00000436
      CALL LINE(XRECP(M),YRECP(M),ZR,X1,Y1,Z1,X2,Y2,Z2,CUP)              00000437
      COUP(M) = CUP*CONVF/WS                                              00000438
```

AD-A061 854 ARGONNE NATIONAL LAB ILL F/G 1/5
AIRPORT VICINITY AIR POLLUTION MODEL ABBREVIATED VERSION USER'S--ETC(U)
SEP 78 L A CONLEY, D M ROTE DOT-FA71WA1-223
UNCLASSIFIED FAA-RD-78-111 NL

2 OF 2
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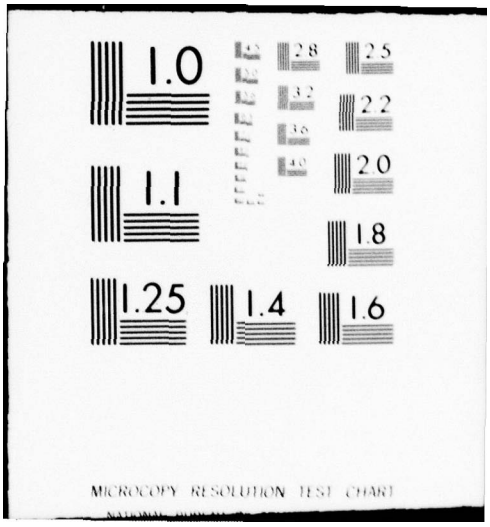
1.0
1.1
1.25
1.4
1.6
2.8
3.2
3.6
4.0
2.5
2.2
2.0
1.8
MICROCOPY RESOLUTION TEST CHART

```
  824 CONTINUE                                                          00000439
C                                                                       00000440
      DO 8415 LL=1,NPT                                                  00000441
      J = IJ(LL)                                                        00000442
      EFUEL = EFUH(J)                                                   00000443
      IF(IFS.EQ.1) EFUEL = EFUL(J)                                      00000444
      ALSE(N,J) = VNOON*DVL *EFUEL *1.609/453.59                        00000445
C                                                                       00000446
      DO 8415 M=1,NSR                                                   00000447
      RECDAT(2,J,M) = RECDAT(2,J,M) + COUP(M)*ALSE(N,J)                 00000448
      RECDAT(4,J,M) = RECDAT(4,J,M) + COUP(M)*ALSE(N,J)                 00000449
 8415 CONTINUE                                                          00000450
  828 CONTINUE                                                          00000451
  301 CONTINUE                                                          00000452
      IF(NACT.EQ.0) GO TO 3402                                          00000453
C                                                                       00000454
C                     TERMINAL AREA AS AREA SOURCE                      00000455
C.. ATTRIBUTABLE EMISSIONS ARE THE FOLLOWING:                           00000456
C         1. SERVICE VEHICLES (14 TYPES)                                00000457
C         2. AUXILIARY POWER UNITS                                      00000458
C         3. AIRCRAFT WHILE IN THE INBOUND TAXI MODE                    00000459
C         4. AIRCRAFT WHILE ENGINE THROTTLE IS SET TO IDLE              00000460
C                                                                       00000461
C                                                                       00000462
      TA = (273.+5.*(TEMP-32.)/9.)/273.                                 00000463
      NRECPT = NSR                                                      00000464
      ZRECPG = HTAERO                                                   00000465
      SCTOPI = SO2PI                                                    00000466
C                                                                       00000467
      NSRC = NANA + NACA                                                00000468
      IF(NSRC.EQ.0) GO TO 3402                                          00000469
C                                                                       00000470
C.. INPUT AREA SOURCE COORDINATES AND THE INITIAL DIMENSIONS OF WIDTH   00000471
C.. AND HEIGHT.                                                         00000472
C                                                                       00000473
      IF(NACA.EQ.0) GO TO 116                                           00000474
      READ(INPUT,441) XS(1),YS(1),STKH(1),WIT(1)                        00000475
      WIT(1) = WIT(1)/2.0                                               00000476
C                                                                       00000477
C..1. SERVICE VEHICLES IN THE TERMINAL AREA                             00000478
C                                                                       00000479
C.. INPUT POLLUTANT EMISSION FACTORS FOR BOTH DIESEL(GM/GAL) AND        00000480
C.. GASOLINE(GM/MI) ENGINES.                                            00000481
C                                                                       00000482
      IF(DEFAULT(17).NE.0)                                              00000483
     1READ(INPUT,3)(EFD(IJ(I)),I=1,NPT)                                 00000484
      IF(DEFAULT(18).NE.0)                                              00000485
     1READ(INPUT,3)(EFG(IJ(I)),I=1,NPT)                                 00000486
      WRITE(OUTPUT,574)(NAME(IJ(I)),EFD(IJ(I)),I=1,NPT)                 00000487
      WRITE(OUTPUT,575)(NAME(IJ(I)),EFG(IJ(I)),I=1,NPT)                 00000488
  574 FORMAT(T5,'POLLUTANT EMISSION FACTORS(DIESEL ENGINE) GM/GAL',/,    00000489
     1(T5,A4,'= ',F10.2))                                               00000490
  575 FORMAT(T5,'POLLUTANT EMISSION FACTORS(GASOLINE ENGINE) GM/MI',/,   00000491
     1(T5,A4,'= ',F10.2))                                               00000492
      DO 443 I = 1,NSVR                                                 00000493
```

```
      SRVHR(I) = 0.0                                                    00000494
C                                                                       00000495
C.. INPUT SERVICE VEHICLE OPERATION TIME (MIN)                          00000496
C                                                                       00000497
      IF(DEFAULT(19).NE.0)                                              00000498
     1READ(INPUT,25)(SRVTIM(J,I),J=1,NACT)                              00000499
C                                                                       00000500
      DO 410 J=1,NACT                                                   00000501
  410 SRVHR(I) = SRVHR(I) + SRVTIM(J,I)*NAC(J)/60.                      00000502
  443 CONTINUE                                                          00000503
      WRITE(OUTPUT,772)                                                 00000504
      DO 411 I=1,14                                                     00000505
      WRITE(OUTPUT,415) SRNAME(I),(SRVTIM(J,I),J=1,NACT)                00000506
  411 CONTINUE                                                          00000507
C                                                                       00000508
C                                                                       00000509
      DIESEL = 0.0                                                      00000510
      GSOLN = 0.0                                                       00000511
      IUNIT = 1                                                         00000512
      CALL CTEMC(I,SRVHR,IUNIT,PELTNT,DIESEL,GSOLN,NPT)                 00000513
C                                                                       00000514
C..2. AUXILIARY POWER UNITS IN THE TERMINAL AREA                        00000515
C                                                                       00000516
C.. INPUT APU USE FLAGS AND APU POLLUTANT EMISSION RATE.                00000517
C                                                                       00000518
      IF(DEFAULT(20).NE.0)                                              00000519
     1READ(INPUT,5)(KAPU(I),I=1,NACT)                                   00000520
      IF(DEFAULT(21).NE.0)                                              00000521
     1READ(INPUT,3)(APU(IJ(I)),I=1,NPT)                                 00000522
C                                                                       00000523
C..3. EMISSIONS FROM AIRCRAFT WHILE IN THE INBOUND TAXI MODE            00000524
C...                                                                    00000525
C                                                                       00000526
C..4. EMISSIONS FROM AIRCRAFT WHILE ENGINE THROTTLE IS SET TO IDLE.     00000527
C                                                                       00000528
C.. INPUT TIME(HOURS) SPENT IN IDLE MODE, AND GATE OCCUPANCY TIME(MIN). 00000529
C                                                                       00000530
      IF(DEFAULT(22).NE.0)                                              00000531
     1READ(INPUT,25)(FIDLE(I),I=1,NACT)                                 00000532
      WRITE(OUTPUT,595)(FIDLE(I),I=1,NACT)                              00000533
      IF(DEFAULT(23).NE.0)                                              00000534
     1READ(INPUT,25)(TGND(I),I=1,NACT)                                  00000535
C                                                                       00000536
      DO 111 LL=1,NPT                                                   00000537
      I = IJ(LL)                                                        00000538
      TMPLNT = 2*WIT(I)                                                 00000539
      DO 112 K=1,NACT                                                   00000540
      GTOT = TGND(K)/60.                                                00000541
      EMID(J) = NAC(K)*NGIN(K)*FIDLE(K)*EMI(INGN(K),2,J) + EMID(J)      00000542
      TERM(J) = NAC(K)*NGIN(K)*EMI(INGN(K),1,J)*TMPLNT/FTAXI(K)+TERM(J) 00000543
      EAPU(J) = APU(J)*NAC(K)*GTOT*KAPU(K) + EAPU(J)                    00000544
  112 CONTINUE                                                          00000545
C                                                                       00000546
C           TOTAL EMISSIONS IN THE TERMINAL AREA.. EMIT(J,1)            00000547
C                                                                       00000548
```

```
  111 EMIT(J,L) =   PLLTNT(J) + TERM(J) + EMID(J) + EAPU(J)                    00000549
  116 CONTINUE                                                                 00000550
      IF(NANA.EQ.0) GO TO 115                                                  00000551
C                                                                              00000552
C.. INPUT AIRPORT NON-AIRCRAFT AREA SOURCE COORDINATES, THE INITIAL            00000553
C.. DIMENSIONS OF WIDTH AND HEIGHT, AND THE POLLUTANT EMISSION RATE.           00000554
C                                                                              00000555
      N = 2                                                                    00000556
      IF(NACA.EQ.0) N=1                                                        00000557
      READ(INPUT,441) XS(N),YS(N),STKH(N),WIT(N)                               00000558
      WRITE(OUTPUT,9714) XS(N),YS(N),STKH(N),WIT(N)                            00000559
      READ(INPUT,3)(EMIT(IJ(J),N),J=1,NPT)                                    00000560
      WIT(N) = WIT(N)/2.0                                                      00000561
C                                                                              00000562
  115 CONTINUE                                                                 00000563
      DO 211 N=1,NSRC                                                          00000564
      CWS(N)=XS(N)*COSWD-YS(N)*SINWD                                           00000565
  211 DWS(N)=-XS(N)*SINWD-YS(N)*COSWD                                          00000566
      DO 212 N=1,NRECPT                                                        00000567
      DWR(N)=-XRECP(N)*SINWD-YRECP(N)*COSWD                                    00000568
      CWR(N)=XRECP(N)*COSWD-YRECP(N)*SINWD                                     00000569
  212 CONTINUE                                                                 00000570
      IF(NSRC.EQ.0) GO TO 3402                                                 00000571
      DO  2402 NS=1,NSRC                                                       00000572
      HEFF(NS)=STKH(NS)                                                        00000573
      KSTAB(NS)=0                                                              00000574
      IF(HEFF(NS).GT.HLID)KSTAB(NS)=1                                          00000575
      WSMD=WS                                                                  00000576
      DLZ=2.*STKH(NS)/(2.4*5280.)                                              00000577
      DSS=2.*WIT(NS)/2.4                                                       00000578
      KL=0                                                                     00000579
      AMOD=A                                                                   00000580
      BMOD=B                                                                   00000581
      CALL PSEUDO(DSS,AMOD,BMOD,TX,TY,TZ,DX,DY,JSTAB,DLZ,KL)                   00000582
      KSTABS=KSTAB(NS)                                                         00000583
      HEFFS=HEFF(NS)                                                           00000584
      DELY=DSS*2.4                                                             00000585
      DELZ=DLZ*2.4                                                             00000586
      TXT=TX                                                                   00000587
      TYT=TY                                                                   00000588
      TZT=TZ                                                                   00000589
      HIWIT=ZRECPG                                                             00000590
      DO 2409 NR=1,NRECPT                                                      00000591
      STWIT=WIT(NS)                                                            00000592
      DW=DWR(NR)-DWS(NS)                                                       00000593
      CW=CWR(NR)-CWS(NS)                                                       00000594
      HRECPT = ZRECP(NR)                                                       00000595
      PEA=1.                                                                   00000596
      IF(DW.LE.-WIT(NS)) GO TO 2409                                            00000597
      NREFLAG=0                                                                00000598
      IBACK=0                                                                  00000599
      IF(DW.LE.WIT(NS)) GO TO 231                                              00000600
      IF((DWR(NR)-XL).GE.(DWS(NS)+WIT(NS))) GO TO 241                          00000601
  231 IF((DWR(NR)-XL).LT.(DWS(NS)-WIT(NS))) GO TO 232                          00000602
      PEA=((CW-XL+WIT(NS))/(2.*WIT(NS))                                        00000603
```

```
      DWSS=((DWS(NS)-WIT(NS))*(DWR(NP)-XL))/2.                          00000604
      W=WI(NP)-DWSS                                                     00000605
      WIT(NS)=((DWR(NP)-XL)-(DWS(NS)-WIT(NS)))/2.                       00000606
      IBACK=1                                                           00000607
      GO TO 241                                                         00000608
  240 NPFLAG=1                                                          00000609
      PEA=1.                                                            00000610
      PERFORM  AREA SOURCE DISPERSION CALCULATIONS BY FUNCTION          00000611
     "TRAN".                                                            00000612
  241 TEM=TRANS(NS,XSTANS,HEFFS,NPFLAG,IBACK)*CONVF                     00000613
      WIT(NS)=STWIT                                                     00000614
      TEM=TEM*PEA                                                       00000615
      DO 240 LL = 1,NPT                                                 00000616
      XX = IJ(LL)                                                       00000617
      IXPT = 1                                                          00000618
      IF(IBACK.EQ.0) IXPT = 2                                           00000619
      IF(NSEC.EQ.2) IXPT = NS                                           00000620
      PER EACH RECEPTOR NP, SUM OVER ALL CONTRIBUTIONS FROM             00000621
      AREA SOURCES.                                                     00000622
      RECDAT(IXPT,KP,NP)=RECDAT(IXPT,KP,NP)+EMIT(KP,NS)*TEM            00000623
      RECDAT(4,KP,NP)=RECDAT(4,KP,NP)+EMIT(KP,NS)*TEM                  00000624
  240 CONTINUE                                                          00000625
      IF(NSEC.EQ.1) GO TO 232                                           00000626
  232 CONTINUE                                                          00000627
      GO TO 5000                                                        00000628
      CONTINUE                                                          00000629
      CONTINUE                                                          00000630
C     CONVERT CONCENTRATIONS FROM MICRO-GRAMS PER CUBIC METER INTO      00000631
C     PARTS PER MILLION.                                                00000632
      DO 55 J=1,NSEC                                                    00000633
      DO 56 LL=1,NPT                                                    00000634
      XX = IJ(LL)                                                       00000635
      DO 58 K=1,4                                                       00000636
   58 RECDAT(K,XX,J) = RECDAT(K,XX,J)* TN/CON(NOP)                      00000637
C     OUTPUT CALCULATED POLLUTANT CONCENTRATIONS                        00000638
      WRITE(OUTPUT,20) (NAME(IJ(LL)),LL=1,NPT)                          00000639
   20 FORMAT(1H1,///,1X,79('*'),/,1X,'*',T80,'*',/,                     00000640
     1 1X,'*',19X,'POLLUTANT EMISSION RATE (POUNDS)',T80,'*',/,1X,'*',  00000641
     2 T80,'*',/,1X,'* ',31X,5(A4,6X) )                                 00000642
      WRITE(OUTPUT,22) (SMLN(IJ(J)),J=1,NPT)                            00000643
   22 FORMAT(1H+,T80,'*',/,1X,'* AIRCRAFT LANDING  ',4X,5(F10.1) )      00000644
   23 FORMAT(1H+,T80,'*',/,1X,'* OUTBOUND QUEUING  ',4X,5(F10.1))       00000645
      WRITE(OUTPUT,24) (SMTF(IJ(J)),J=1,NPT)                            00000646
   24 FORMAT(1H+,T80,'*',/,1X,'* AIRCRAFT TAKE-OFF ',4X,5(F10.1) )      00000647
      WRITE(OUTPUT,26) (RWIL(IJ(J),1),J=1,NPT)                          00000648
      WRITE(OUTPUT,27) (RWIL(IJ(J),2),J=1,NPT)                          00000649
   26 FORMAT(1H+,T80,'*',/,1X,'* INBOUND APRCH     ',4X,5(F10.1) )     00000650
      WRITE(OUTPUT,27) (SMTXI(IJ(J)) ,J=1,NPT)                          00000651
      WRITE(OUTPUT,45)(SMTXO(IJ(J)) ,J=1,NPT)                           00000652
   45 FORMAT(1H+,T80,'*',/,1X,'* OUTBOUND TAXIWAY  ',4X,5(F10.1))       00000653
   27 FORMAT(1H+,T80,'*',/,1X,'* INBOUND TAXIWAY   ',4X,5(F10.1) )      00000654
      WRITE(OUTPUT,28) (PLLNT(IJ(J)),J=1,NPT)                           00000655
      WRITE(OUTPUT,29) (SAPU(IJ(J)),J=1,NPT)                            00000656
   29 FORMAT(1H+,T80,'*',/,1X,'* AUX. POWER UNIT',7X,5(F10.1) )         00000657
      WRITE(OUTPUT,1?)(TCP(IJ(J)),J=1,NPT)                              00000658
```

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   13 FORMAT(1H+,T80,'*',/,1X,'* TERM. AREA TAXI    ',4X,5(F10.1))        00000659
C                                                                         00000660
      WRITE(OUTPUT,15)(EMID(IJ(J)),J=1,NPT)                               00000661
   15 FORMAT(1H+,T80,'*',/,1X,'* TERM AREA ENG. IDLE',3X,5(F10.1))        00000662
      WRITE(OUTPUT,29) (EMIT(IJ(J),1),J=1,NPT)                            00000663
   29 FORMAT(1H+,T80,'*',/,1X,'* AIRCRAFT AREA',9X,5(F10.1) )             00000664
      WRITE(OUTPUT,30) (EMIT(IJ(J),2),J=1,NPT)                            00000665
   30 FORMAT(1H+,T80,'*',/,1X,'* NON-AIRCRAFT AREA',5X,5(F10.1) )         00000666
   32 FORMAT(1H+,T80,'*',/,1X,'* SERVICE VEHICLE',7X,5(F10.1) )           00000667
      IF(NAVR.EQ.0) GO TO 1001                                            00000668
      WRITE(6,33)                                                         00000669
   33 FORMAT(1H+,T80,'*',/,1X,'* ACCESS VEHICLE')                         00000670
      DO 37 N=1,NAVR                                                      00000671
      WRITE(OUTPUT,35) N,(ALSE(N,IJ(J)),J=1,NPT)                          00000672
   35 FORMAT(1H+,T80,'*',/,1X,'*',16X,I3,4X,5(F10.1) )                    00000673
   37 CONTINUE                                                            00000674
      WRITE(OUTPUT,38)                                                    00000675
   38 FORMAT(1H+,T80,'*',/,1X,79('*'),//)                                 00000676
      WRITE(OUTPUT,1000)                                                  00000677
 1000 FORMAT(1H1)                                                         00000678
 1001 CONTINUE                                                            00000679
      DO 16 N=1,NSR                                                       00000680
      WRITE(OUTPUT,81) NRUSED(N),XRECP(N),YRECP(N),(NAUT(IJ(J)),J=1,NPT)  00000681
   81 FORMAT( 1X,79('*'),/,1X,'*',T80,'*',/,                              00000682
     11X,'*',9X,'POLLUTANT CONCENTRATIONS : M/CM=MICROGRAMS PER CUBIC ME  00000683
     -TER',T80,'*',/,1X,'*'T80,                                           00000684
     2'*',/,1X,'*',19X,'RECEPTOR',I4,T80,'*',/,1X,'*',T80,'*',/,1X        00000685
     3 ,'*',19X,'COORDINATES (',F7.3,',',F7.3,')',T80,'*',/,2(1X,'*',T800 00000686
     4,'*',/),1X,'*', 31X,5(A6,2X) )                                      00000687
      WRITE(OUTPUT,83) (RECDAT(1,IJ(L),N),L=1,NPT)                        00000688
   82 FORMAT(1H+,T80,'*',/,1X,'* AIRCRAFT LINE ',11X,5(F10.3) )           00000689
      WRITE(OUTPUT,84)(RECDAT(2,IJ(L),N),L=1,NPT)                         00000690
   83 FORMAT(1H+,T80,'*',/,1X,'* AIRCRAFT AREA ',11X,5(F10.3) )           00000691
      WRITE(OUTPUT,82)(RECDAT(3,IJ(L),N),L=1,NPT)                         00000692
   84 FORMAT(1H+,T80,'*',/,1X,'* NON-AIRCRAFT AREA-LINES',2X,5(F10.3))    00000693
      WRITE(OUTPUT,85)(RECDAT(4,IJ(L),N),L=1,NPT)                         00000694
   85 FORMAT(1H+,T80,'*',/,1X,'*',12X,'TOTAL',9X,5(F10.3))                00000695
      WRITE(OUTPUT,38)                                                    00000696
   16 CONTINUE                                                            00000697
C..... INPUT FORMATS...                                                   00000698
C                                                                         00000699
 4711 FORMAT(I2,3F8.0)                                                    00000700
   12 FORMAT(15X,6I5)                                                     00000701
    5 FORMAT(5X,15I5)                                                     00000702
    1 FORMAT(6X,2313)                                                     00000703
   25 FORMAT(5X,15F5.0)                                                   00000704
    3 FORMAT(15X,5F10.0)                                                  00000705
  323 FORMAT(15X,2F10.0)                                                  00000706
 1244 FORMAT(15X,6F10.0)                                                  00000707
  311 FORMAT(10X,6F10.0,F8.0,I2)                                          00000708
  415 FORMAT(1X,A8,5X,10F5.1)                                             00000709
  441 FORMAT(15X,4F10.0)                                                  00000710
C                                                                         00000711
   31 FORMAT(1X,'POLLUTANT CHOICE          ',10A4)                        00000712
   34 FORMAT(1X,'AIRPORT PARAMETERS:',/,                                  00000713
```

```
     1T24,'NUMBER OF RECEPTORS',                                          00000714
     2'(I_'),I4,/,T24,'NUMBER OF RUNWAYS',                                00000715
     3'(I_'),I4,/,T24,'NUMBER OF TAXIWAYS',                               00000716
     4'(I_'),I4,/,T24,'NUMBER OF APRONS',                                 00000717
     5'(I_'),I4,/,T24,'NUMBER OF TERMINAL AREAS',                         00000718
     6'(I_'),I4,/,T24,'NUMBER OF AIRCRAFT TYPES',                         00000719
     7'(I_'),I4,/,T24,'NUMBER OF AIRCRAFT ENGINE TYPES',                  00000720
     8'(I_'),I4,/,T24,'NUMBER OF SERVICE VEHICLE TYPES',                  00000721
     9'(I_'),I4,/,T24,'NUMBER OF ACCESS VEHICLE ROADWAYS',                00000722
     A'(I_'),I4,/,T24,'NUMBER OF AIRPORT NON-AIRCRAFT AREA SOURCES',      00000723
     B'(I-'),I4)                                                          00000724
 592 FORMAT(T2,'TAXI SPEED      ',T20,10F6.1)                             00000725
 593 FORMAT(T2,'INBOUND SPEED   ',T20,10F6.1)                             00000726
 594 FORMAT(T2,'OUTBOUND SPEED  ',T20,10F6.1)                             00000727
 595 FORMAT(T2,'IDLE TIME       ',T20,10F7.5)                             00000728
 597 FORMAT(T2,'LANDING TIME    ',T20,10F7.5)                             00000729
 598 FORMAT(T2,'TAKE-OFF TIME   ',T20,10F7.5)                             00000730
 591 FORMAT(T5,'AIRCRAFT OPERATION SPEED(MI/HR), AND TIME(HR)')           00000731
 150 FORMAT(12X,11,5(F6.2,2X))                                            00000732
 571 FORMAT(T5,'NUMBER OF ENGINES PER AIRCRAFT',T40,15I5)                 00000733
 570 FORMAT(T5,'AIRCRAFT ENGINE TYPES',T40,15I5)                          00000734
 577 FORMAT(T5,'AUXILIARY POWER UNIT FLAGS',T40,15I5)                     00000735
 772 FORMAT(T5,'SERVICE VEHICLE OPERATION TIME(MIN.):')                   00000736
 773 FORMAT(T5,'POLLUTANT EMISSION FACTORS-- 25MPH URBAN AUTOMOBILE TRA00000737
    1FFIC:',/,T5,5F6.2)                                                   00000738
 774 FORMAT(T5,'POLLUTANT EMISSION FACTORS-- 10 MPH URBAN AUTOMOBILE TR00000739
    1AFFIC:',/,T5,5F6.2)                                                  00000740
 721 FORMAT(1X,'RUNWAY PARAMETERS:',/,(T5,8F10.5))                        00000741
 715 FORMAT(1X,'HORIZONTAL AND VERTICAL SPREAD:',/,T5,'RUNWAYS ',         00000742
    1F10.5,/,T5,'TAXIWAYS',2F10.5,/,T5,'APRONS  ',2F10.5)                 00000743
 711 FORMAT(1X,I4,' RECEPTOR COORDINATES (X,Y,Z):',/,                     00000744
    1(T5,3F6.1))                                                          00000745
 726 FORMAT(1X,'I=0',26I3)                                                00000746
 573 FORMAT(1X,' ANEMOVANE HEIGHT =',F6.1,' FT.',3X,'WIND SPEED =',F6.2,00000747
    1' MPH',3X,'WIND DIRECTION= ',F4.0,' DEGREES',/,1X,'AMBIENT TEMPERA00000748
    2TURE =',F4.1,' F DEGREES',2X,'STABILITY CLASS INDEX =',I1,,2X,'LID00000749
    3 HEIGHT =',F5.1,' FT.')                                              00000750
 716 FORMAT(1X,' AREA SOURCES((X,Y),HEIGHT,WIDTH)',/,(T5,4F10.5))         00000751
   4 FORMAT(5F8.0)                                                        00000752
1255 FORMAT(2F8.0)                                                        00000753
 571 FORMAT(1X,'END-POINT COORDINATES OF RUNWAYS',/,(T5,6F10.5))          00000754
 571 FORMAT(1X,'END-POINT COORDINATES OF TAXIWAYS',/,(T5,6F10.5))         00000755
 577 FORMAT(1X,'END-POINT COORDINATES OF APRONS',/,(T5,6F10.5))           00000756
 573 FORMAT(1X,'END-POINT COORDINATES, TRAFFIC INTENSITIES, AND INDICAT00000757
    1ES FOR ACCESS VEHICLE ROADWAYS')                                     00000758
 572 FORMAT(T5, 7F10.2,I5)                                                00000759
 250 FORMAT(5F8.0)                                                        00000760
 45  FORMAT(I5F4.0)                                                       00000761
     STOP                                                                 00000762
     END                                                                  00000763
```

```
      BLOCK DATA                                                        00000764
      INTEGER DFAULT(23)                                                00000765
      REAL*8 SRNAME(14)                                                 00000766
      COMMON/SERVHL/SRNAME                                              00000767
C                                                                       00000768
      COMMON/DEFLT/NAC(10),FLNDG(10),FTKOF(10),NGIN(10),INGN(10),       00000769
     1EMI(5,4,5),DSRW,HRW, FTAXI(10),                                   00000770
     2FTXII(10),FTXIO(10),DSTW,HTW,DSKA,HRA,EFUM(5),EFUL(5),DSAR,HAR,   00000771
     3SRVTIM(10,14),KAPU(10),APU(5),FIDLE(10),TGND(10),DFAULT           00000772
      COMMON/FUEL/EFD(5),EFG(5)                                         00000773
      COMMON/LN/DL,XW1,YW1,ZW1,XW2,YW2,ZW2,COEF1,COEF2,VA1,VA2,VD1,VD2,  00000774
     -C,TIME,VA12,VA22,VD12,VD22,WS2,WSC,JAE,SNAN,CSAN,V1,V2,V12,V22,   00000775
     -TAIL,VS,RR,SP                                                     00000776
      DATA NAC/10*10/                                                   00000777
      DATA FLNDG/6*.0153,.011,.0153,.011,.011/                          00000778
      DATA FTKOF/10*.0111/                                              00000779
      DATA NGIN/3,9*2/                                                  00000780
      DATA INGN/1,1,1,3,4,3,2,3,2,5/                                    00000781
      DATA EMI/37.,3.53,15.,60.,11.41,37.,3.53,15.,60.,11.41,           00000782
     -25.6,2.58,10.1,45.6,11.41,6.,.39,2.,14.,72.52,9.,.88,6.,66.,.38   00000783
     -,9.,.68,6.,66.,.38,5.6,.24,3.8,40.3,.38,.4,.05,.4,0.0,1.66,       00000784
     -2.,.96,2.0,1.,.01,2.,.96,2.,1.,.01,36.3,1.69,8.,42.1,.01,         00000785
     -133.3,3.64,23.,153.,.23,.5,.1,.1,.04,.06,.5,.1,.1,.04,.06,        00000786
     -6.8,.38,.3,.3,.06,21.,.62,.6,.8,.12,.9,.5,.5,.6,.01,.9,.5,.5,     00000787
     -.6,.01,3.2,.5,.9,2.2,.01,8.6,1.9,1.9,6.2,.07/                     00000788
      DATA DSRW,HRW/.03,.002/                                           00000789
      DATA VA1,VA2,VD1,VD2,TIME,TAIL/145.,25.,0.0,180.,.0111,.08523/    00000790
C                                                                       00000791
      DATA FTAXI/10*10./                                                00000792
      DATA FTXII/10*15./                                                00000793
      DATA FTXIO/10*12./                                                00000794
      DATA DSTW,HTW/.03,.002/                                           00000795
C                                                                       00000796
      DATA DSKA,HRA/.095,.002/                                          00000797
C                                                                       00000798
      DATA EFUM/32.36,4.75,3.46,.19,.11/                                00000799
      DATA EFUL/70.18,8.62,2.86,.19,.11/                                00000800
      DATA DSAR,HAR/.0095,.001/                                         00000801
C                                                                       00000802
      DATA EFD/126.6,21.9,185.82,5.9,0.0/                               00000803
      DATA EFG/138.81,21.35,9.32,.85,0.0/                               00000804
C                                                                       00000805
C                                                                       00000806
      DATA SRVTIM/66.,48.,85.,55.,50.,50.,4*0.0,28.,15.,30.,0.0,        00000807
     -            25.,25.,4*0.0,6.,9*0.0,12.,0.,15.,7*0.0,             00000808
     -            15.,15.,15.,10.,10.,10.,5.,5.,5.,0.0,                00000809
     -            0.,10.,0.,10.,10.,10.,5.,5.,5.,0.0,                  00000810
     -            17.,17.,20.,10.,10.,10.,0.,0.,0.,0.,                 00000811
     -            20.,15.,15.,10.,20.,20.,10.,10.,10.,0.0,             00000812
     -            10.,5.,5.,5.,5.,5.,44*0.3,9*0./                      00000813
C                                                                       00000814
C.. NAME THE 14 SERVICE VEHICLE TYPES.                                  00000815
C                                                                       00000816
```

```
      DATA SRNAME/'TRACTOR ','BELT LRD','CONT LDR','CAR SER ','LAV TRK '00000817
     -,'WAT TRK ','FOOD SRV','FUEL TRK','TOW TCTR','CONDTNR ','AIR STRT'00000818
     -,'GPU FRNT','GPU REAR','TRANSPTR'/                                00000819
                                                                        00000820
      DATA KAPU/4*1.6*0/                                                00000821
      DATA APU/2.82,.11,1.24,0.,.0./                                    00000822
      DATA FIDLE/10*.033/                                               00000823
      DATA TGND/10*52./                                                 00000824
      DATA DEAULT/23*0/                                                 00000825
      END                                                               00000826
```

```
      SUBROUTINE GASOLN(XMIHR,XMIGAL,GAL,XMILE,PLLTNT,NPLTS,IUNIT)      00000827
C-----XMIHR=ASSUMED AVERAGE VEHICLE SPEED                               00000828
C-----XMIGAL=ASSUMED MILES PER GALLON                                   00000829
C-----GAL = GALLONS OF FUEL CONSUMED                                    00000830
C-----IF DATA GIVEN IN VEHICLE MILES, GAL MUST BE SET EQUAL TO 0.0      00000831
C-----XMILE=TOTAL MILES; SET EQUAL TO 0.0 IF USING GALLONS              00000832
C-----XPT,XCO,ETC. ARE THE EMISSIONS IN UNITS OF POUNDS OR GRAMS FOR    00000833
C-----PARTICULATES, CARBON MONOXIDE, HYDROCARBONS, ETC.                 00000834
C-----IUNIT = 0 MEANS EMISSIONS IN GRAMS ELSE EMISSIONS IN POUNDS.      00000835
C                                                                       00000836
      DIMENSION PLLTNT(5)                                               00000837
      COMMON/PCL/NPT,JJ(5)                                              00000838
      COMMON/FUEL/EFD(5),EF(5)                                          00000839
C*****************************************************************    00000840
C       GASOLINE ENGINE POWERED MOTOR VEHICLE EMISSIONS ARE COMPUTED ON 00000841
C       THE BASIS OF STANDARD EMISSION FACTORS AND ASSUMED SPEED        00000842
C       DEPENDENCE.                                                     00000843
C*****************************************************************    00000844
C                                                                       00000845
      SPCO=12.5*(XMIHR)**(-0.845)                                       00000846
      SPHC=7.0*(XMIHR)**(-0.649)                                        00000847
      SPNO=1.0+0.01262*(XMIHR-19.6)                                     00000848
      A=XMIGAL*GAL                                                      00000849
      IF(GAL.EQ.0.0) A=XMILE*XMIGAL/12.5                                00000850
      DO 9 J=1,NPLTS                                                    00000851
      I = JJ(J)                                                         00000852
      IF(I.EQ.4) FACT = A*EF(4)                                         00000853
      IF(I.EQ.3) FACT = A*EF(3)*SPNO                                    00000854
      IF(I.EQ.1) FACT = A*EF(1)*SPCO                                    00000855
      IF(I.EQ.2) FACT = A*EF(2)*SPHC                                    00000856
      PLLTNT(I) = FACT                                                  00000857
      IF(IUNIT.NE.0) PLLTNT(I) = FACT/454.                              00000858
    9 CONTINUE                                                          00000859
      RETURN                                                            00000860
      END                                                               00000861
```

```
      FUNCTION CAVL(XR,YR,ZR)                                                   00000862
      COMMON/LN/DL,XW1,YW1,ZW1,XW2,YW2,ZW2,COEF1,COEF2,VA1,VA2,VD1,VD2,         00000863
     -S,TIME,VA12,VA22,VD12,VD22,WS2,WSC,IAD,SNAN,CSAN,V1,V2,V12,V22,           00000864
     -TAIL,VS,RR,SP                                                             00000865
      COMMON/MET/WS,WD,JSTAB,HLID,TEMP,XZ,SUDOY,SUDOZ                           00000866
C*************************************************************************0000867
C  CALCULATION OF POLLUTANT CONCENTRATION DUE TO FINITE LINE SOURCE.          00000868
C*************************************************************************00000869
      ISUB=0                                                                    00000870
      NSUB=0                                                                    00000871
      ISAC=0                                                                    00000872
      CBAR=0.                                                                   00000873
      CAN=0.7071                                                                00000874
      EMIN=30./5280.                                                            00000875
      HLIDM=HLID/5280.                                                          00000876
C  INTRODUCE A GENERAL SET OF NOTATION SO THAT SAME DISPERSION CALCULATI00000877
C  CAN BE USED FOR SMALL-ANGLE CASE WHERE LINE IS FURTHER SEGMENTED.          00000878
      X1=XW1                                                                    00000879
      Y1=YW1                                                                    00000880
      Z1=ZW1                                                                    00000881
      X2=XW2                                                                    00000882
      Y2=YW2                                                                    00000883
      Z2=ZW2                                                                    00000884
      IF(Z1.GE.HLIDM) GO TO 600                                                 00000885
      IF(Z2.GT.HLIDM) GO TO 11                                                  00000886
      GO TO 5                                                                   00000887
   11 X2=X1+(X2-X1)*(HLIDM-Z1)/(Z2-Z1)                                          00000888
      Y2=Y1+(Y2-Y1)*(HLIDM-Z1)/(Z2-Z1)                                          00000889
      Z2=HLIDM                                                                  00000890
    5 DLXY=(X2-X1)**2+(Y2-Y1)**2                                                00000891
      DLI=SQRT(DLXY)                                                            00000892
      IF (DLI.EQ.0.AND.Z1.EQ.Z2)GO TO 600                                       00000893
      DLXYZ=DLXY+(Z2-Z1)**2                                                     00000894
      DLN=SQRT(DLXYZ)                                                           00000895
      IF(ISUB.NE.0) GO TO 6                                                     00000896
      DLRS=DLN                                                                  00000897
      CSTH=DLI/DLN                                                              00000898
      SNTH=(Z2-Z1)/DLN                                                          00000899
      PROJL=Y2-Y1                                                               00000900
      IF(ABS(PROJL).LT.1.E-20)PROJL=0.                                          00000901
      SNFI=PROJL/DLI                                                            00000902
      ASNF=ABS(SNFI)                                                            00000903
    6 CONTINUE                                                                  00000904
      IF(Y1.GT.Y2) GO TO 1                                                      00000905
      XF=X2                                                                     00000906
      YF=Y2                                                                     00000907
      XL=X1                                                                     00000908
      YL=Y1                                                                     00000909
      GO TO 2                                                                   00000910
    1 XF=X1                                                                     00000911
      YF=Y1                                                                     00000912
      XL=X2                                                                     00000913
      YL=Y2                                                                     00000914
```

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    2 CONTINUE                                                          00000915
C   TEST RECEPTOR LOCATION RELATIVE TO LINE SOURCE AND BRANCH.          00000916
      IF (X1-X2) 27,28,28                                               00000917
   27 XMAX=X2                                                           00000918
      XMIN=X1                                                           00000919
      GO TO 29                                                          00000920
   28 XMAX=X1                                                           00000921
      XMIN=X2                                                           00000922
   29 IF((XMIN-XR).GE..001) GO TO 500                                   00000923
      XFAR=XR-XMIN                                                      00000924
      DWDA=XFAR+SUBDY                                                   00000925
      DWDB=XFAR+SUBDZ                                                   00000926
      IF(DWDA.LE.0..OR.DWDB.LE.0.) GO TO 500                            00000927
      TFAR=DWDA/WS                                                      00000928
      TFBR=DWDB/WS                                                      00000929
      SIGF=SIGY(JSTAB,TFAR)                                             00000930
      SIGFZ=SIGZ(JSTAB,TFBR)                                            00000931
      ARRO=ABS(PROJE)                                                   00000932
      IF(X1.GT.X2) GO TO 21                                             00000933
      XA=X2                                                             00000934
      YA=Y2                                                             00000935
      ZA=Z2                                                             00000936
      XB=X1                                                             00000937
      YB=Y1                                                             00000938
      ZB=Z1                                                             00000939
      GO TO 22                                                          00000940
   21 XA=X1                                                             00000941
      YA=Y1                                                             00000942
      ZA=Z1                                                             00000943
      XB=X2                                                             00000944
      YB=Y2                                                             00000945
      ZB=Z2                                                             00000946
   22 CONTINUE                                                          00000947
      IF(ISAC.EQ.1) GO TO 4                                             00000948
      IF(YR.GT.(YH+4.*SIGF)) GO TO 500                                  00000949
      IF(YR.LT.(YL-4.*SIGF)) GO TO 500                                  00000950
      IF(ZR.GT.(Z2+4.*SIGFZ)) GO TO 500                                 00000951
      IF(ZR.LT.(Z1-4.*SIGFZ)) GO TO 500                                 00000952
C     GO TO 3 IF ANGLE IS SMALL                                         00000953
      IF (ASNF .LT.  CAN .AND. ABS(SNTH) .LT. CAN) GO TO 3              00000954
      IF(YR.GT.(YH+3.*SIGF)) GO TO 500                                  00000955
      IF(YR.LT.(YL-3.*SIGF)) GO TO 500                                  00000956
      IF(ZR.GT.(Z2+3.*SIGFZ)) GO TO 500                                 00000957
      IF(ZR.LT.(Z1-3.*SIGFZ)) GO TO 500                                 00000958
      X=X1+(YR-Y1)*(X2-X1)/(Y2-Y1)                                      00000959
      IF(X.LT.XB) GO TO 333                                             00000960
      IF(X.GT.XA) GO TO 33                                              00000961
      Y=YR                                                              00000962
      GO TO 4                                                           00000963
C     SELECT X,Y VALUES ON LINE FOR SMALL ANGLE CASE                    00000964
    3 X=XR                                                              00000965
      IF(XR.GT.XA) X=XA                                                 00000966
      Y=Y1+(X-X1)*(Y2-Y1)/(X2-X1)                                       00000967
      ISAC=1                                                            00000968
      Z1=Z1+(X-X1)*(Z2-Z1)/(X2-X1)                                      00000969
```

```
      X1=X                                                                  00000970
      Y1=Y                                                                  00000971
      X2=XB                                                                 00000972
      Y2=YB                                                                 00000973
      Z2=ZB                                                                 00000974
      X=0.5*(X1+X2)                                                         00000975
      Y=0.5*(Y1+Y2)                                                         00000976
      GO TO 5                                                               00000977
   33 X=XA                                                                  00000978
      Y=YA                                                                  00000979
      GO TO 4                                                               00000980
  333 X=XB                                                                  00000981
      Y=YB                                                                  00000982
    4 DWD=XR-X                                                              00000983
      DWD1=DWD                                                              00000984
      IF(ISAC.EQ.1) DWD1=XR-X1                                              00000985
      IF(ISAC.EQ.1.AND.NSUB.LE.1) DWD=DWD1                                  00000986
      DWDY1=DWD1+SUDDY                                                      00000987
      DWDY=DWD+SUDDY                                                        00000988
      DWDZ=DWD+SUDDZ                                                        00000989
      IF (DWDY .LE.C. .OR.DWDZ.LE.0..OR.DWDY1.LE.0.)GO TO 500               00000990
      IF(X1.EQ.X2) GO TO 44                                                 00000991
      Z=Z1+(X-X1)*(Z2-Z1)/(X2-X1)                                           00000992
      GO TO 444                                                             00000993
   44 Z=Z1+(Y-Y1)*(Z2-Z1)/(Y2-Y1)                                           00000994
  444 CONTINUE                                                              00000995
C     COMPUTE STANDARD DEVIATIONS.                                          00000996
      THRH=DWDY/WS                                                          00000997
      THRV=DWDZ/WS                                                          00000998
      THRH1=DWDY1/WS                                                        00000999
      SIGH1=SIGY(JSTAB,THRH1)                                               00001000
      ELEM=AMAX1(0.2*DWDY1,SIGH1)                                           00001001
      IF (IAE.NE.0) ISAC=1                                                  00001002
      IF(ISAC.EQ.1)ELEM=.1*ELEM                                             00001003
      IF(ELEM.LT.EMIN) ELEM=EMIN                                            00001004
C     BRANCH IF ANGLE IS SMALL AND LINE SOURCE IS LONG.                     00001005
      IF(IAE.NE.0.AND.DL1.GT.(1.5*ELEM))GO TO 55                            00001006
      IF(ASNE.LT.CAN.AND.DL1.GT.(1.5*ELEM)) GO TO 55                        00001007
      SIGH=SIGY(JSTAB,THRH)                                                 00001008
      SIGV=SIGZ(JSTAB,THRV)                                                 00001009
      DENH=1.4142*SIGH                                                      00001010
      DENZ=1.4142*SIGV                                                      00001011
      IF(ASNE.LT.0.1.AND.(ABS(SNTH)).LT.0.1) GO TO 45                       00001012
      GO TO 445                                                             00001013
   45 ARGZ1=-(ZR-Z1)**2/DENZ**2                                             00001014
      ARGZ2=-(ZR+Z1)**2/DENZ**2                                             00001015
      GO TO 446                                                             00001016
  445 CONTINUE                                                              00001017
      ARG=CSTH**2*SNFI**2*SIGV**2+SNTH**2*SIGH**2                           00001018
      PARG=SQRT(ARG)                                                        00001019
      A=PARG/(1.4142*SIGH*SIGV)                                             00001020
      AL=DLN*A                                                              00001021
      ARG1=(YR-Y1)*CSTH*SNFI*SIGV**2                                        00001022
      ARGZ1=(ZR-Z1)*SNTH*SIGH**2                                            00001023
      ARGZ2=-(ZR+Z1)*SNTH*SIGH**2                                           00001024
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      BA1=-(ARG1+ARG21)/(1.4142*SIGH*SIGV*RARG)                          00001025
      BA2=-(ARG1+ARG22)/(1.4142*SIGH*SIGV*RARG)                          00001026
      ARGY1=AL+BA1                                                       00001027
      ARGY2=AL+BA2                                                       00001028
      C1=(YR-Y1)**2/DENH**2+(ZR-Z1)**2/DENZ**2                           00001029
      C2=(YR-Y1)**2/DENH**2+(ZR+Z1)**2/DENZ**2                           00001030
      ARGZ1=BA1**2-C1                                                    00001031
      ARGZ2=BA2**2-C2                                                    00001032
  446 IF(ARGZ1.LT.-10..AND.ARGZ2.LT.-10.) GO TO 500                      00001033
      IF(ARGZ1.LT.-10.)GOTO 2411                                         00001034
      IF(ARGZ2.LT.-10.)GOTO 2412                                         00001035
      IF(DWD.GT.XZ) GO TO 100                                            00001036
      FAC1=EXP(ARGZ1)                                                    00001037
      FAC2=EXP(ARGZ2)                                                    00001038
      GOTO 2414                                                          00001039
 2411 FAC1=0                                                             00001040
      FAC2=EXP(ARGZ2)                                                    00001041
      GOTO 2414                                                          00001042
 2412 FAC2=0                                                             00001043
      FAC1=EXP(ARGZ1)                                                    00001044
 2414  CONTINUE                                                          00001045
   39 CONTINUE                                                           00001046
C   GET POLLUTANT DENSITY AND ITS GRADIENT(IF ANY).                      00001047
C   MODEL ASSUMES CONSTANT ACCELERATION (OR DE-ACCEL.) AND EMISSION ON RU00001048
C   LANDING AND TAKE-OFF.                                                00001049
      XSI2=(X-XW1)**2+(Y-YW1)**2+(Z-ZW1)**2                              00001050
      XSI=SQRT(XSI2)                                                     00001051
      IF(X*XW2.LT.0.OR.Y*YW2.LT.0.OR.Z*ZW2.LT.0) XSI=-XSI                00001052
      QL = 1./DL                                                         00001053
      IF (IAD .NE. 0) CALL GMOL(XSI,QL)                                  00001054
C   BRANCH IF ANGLE IS SMALL                                             00001055
      IF(ASNF.LT.0.1.AND.(ABS(SNTH)).LT.0.1) GO TO 50                    00001056
      FJ1=FAC1*(ERF(ARGY1)-ERF(BA1))                                     00001057
      FJ2=FAC2*(ERF(ARGY2)-ERF(BA2))                                     00001058
      CBARO=CBAR                                                         00001059
      CBAR=(CBAR+0.35355*COEF1*QL*(FJ1+FJ2)/(A*SIGH*SIGV)                00001060
      IF (CBARO.EQ.0) GO TO 49                                           00001061
      IF(ABS((CBARO-CBAR)/CBAR).LE..00010) GO TO 600                     00001062
      IF(IBUG.EQ.0) GO TO 49                                             00001063
   49 CONTINUE                                                           00001064
      IF(NSUB.GT.1.AND.DLRS.GT.(.01*DL)) GO TO 60                        00001065
      GO TO 600                                                          00001066
C    SMALL-ANGLE APPROXIMATION                                           00001067
   50 ARGYY=-(YR-Y1)**2/DENH**2                                          00001068
      IF(ARGYY.LT.-10.) GO TO 500                                        00001069
      FAC=0.5*(FAC1+FAC2)                                                00001070
      BRAC=EXP(ARGYY)                                                    00001071
 2317  CONTINUE                                                         00001072
      CBARO=CBAR                                                         00001073
      CBAR=CBAR+COEF2*QL*DLN*FAC*BRAC/(SIGH*SIGV)                        00001074
      IF (CBARO.EQ.0) GO TO 499                                          00001075
      IF(ABS((CBARO-CBAR)/CBAR).LE..00010) GO TO 600                     00001076
  499 CONTINUE                                                           00001077
      IF(ASNF.LT.0.001) ASNF=0.001                                       00001078
      IF(NSUB.LT.1) GO TO 600                                            00001079
```

```
      IF(DLRS.LT.(.01*DL)) GO TO 600                                    00001080
      IF(NSUB.GT.1.AND.DLRS.GT.(.01*DL)) GO TO 60                       00001081
   55 NSUB=1.+DL1/ELEM                                                  00001082
      RSUB=NSUB                                                         00001083
      SEGL=ELN/RSUB                                                     00001084
      ISUB=0                                                            00001085
      DELX=(X2-X1)/RSUB                                                 00001086
      DELY=(Y2-Y1)/RSUB                                                 00001087
      DELZ=(Z2-Z1)/RSUB                                                 00001088
      XRS=X2-X1                                                         00001089
      YRS=Y2-Y1                                                         00001090
      ZRS=Z2-Z1                                                         00001091
      X2=X1                                                             00001092
      Y2=Y1                                                             00001093
      Z2=Z1                                                             00001094
   60 ISUB=ISUB+1                                                       00001095
      IF(ISUB.EQ.1) GO TO 65                                            00001096
      NSUB=1.+DLRS/ELEM                                                 00001097
      RSUB=NSUB                                                         00001098
      SEGL=DLRS/RSUB                                                    00001099
      DELX=XRS/RSUB                                                     00001100
      DELY=YRS/RSUB                                                     00001101
      DELZ=ZRS/RSUB                                                     00001102
   65 CONTINUE                                                          00001103
      XRS=XRS-DELX                                                      00001104
      YRS=YRS-DELY                                                      00001105
      ZRS=ZRS-DELZ                                                      00001106
      X1=X2                                                             00001107
      Y1=Y2                                                             00001108
      Z1=Z2                                                             00001109
      X2=X2+DELX                                                        00001110
      Y2=Y2+DELY                                                        00001111
      Z2=Z2+DELZ                                                        00001112
      DLRS=DLRS-SEGL                                                    00001113
      X=.5*(X1+X2)                                                      00001114
      Y=.5*(Y1+Y2)                                                      00001115
      Z=.5*(Z1+Z2)                                                      00001116
      GO TO 5                                                           00001117
  100 YL = Y1                                                           00001118
      ZL = Z1                                                           00001119
      IF (Z1 .LE. Z2) GO TO 105                                         00001120
      YL = Y2                                                           00001121
      ZL = Z2                                                           00001122
  105 RAD=0.5*SIGV/(COEFF1*HLIDM)                                       00001123
      IF(DWL.GT.2.*XZ) GO TO 200                                        00001124
      DENZL=0.47*HLIDM                                                  00001125
      DENZL2=DENZL**2                                                   00001126
      IF(ASNF.LT.0.1.AND.(ABS(SNTH)).LT.0.1) GO TO 101                  00001127
      GO TO 102                                                         00001128
  101 ARGZ1=-(ZR-ZL)**2/DENZL**2                                        00001129
      ARGZ2=-(ZR+ZL)**2/DENZL**2                                        00001130
      GO TO 103                                                         00001131
  102 TL=XZ/WS                                                          00001132
      DENHL=1.4142*SIGV(JSTAB,TL)                                       00001133
      DENC=(SNTH**2*SNFI**2*DENZL**2+SNTH**2*DENHL**2                   00001134
```

```
      ARGZ1=-((YR-YL)*SNTH-(ZR-ZL)*CSTH*SNFI)**2/DENO                    00001135
      ARGZ2=-((YR-YL)*SNTH-(ZR+ZL)*CSTH*SNFI)**2/DENO                    00001136
  103 FAC1=EXP(ARGZ1)                                                    00001137
      FAC2=EXP(ARGZ2)                                                    00001138
      FAC1=FAC1+(DWC-XZ)*(FAC3-FAC1)/XZ                                  00001139
      FAC2=FAC2+(DWC-XZ)*(FAC3-FAC2)/XZ                                  00001140
      GO TO 39                                                           00001141
  200 FAC1=FAC3                                                          00001142
      FAC2=FAC3                                                          00001143
      GO TO 39                                                           00001144
  500 IF(DLRS.LT.(.01*DL)) GO TO 600                                     00001145
      IF(ISAC.EQ.1.AND.NSUB.EQ.0) GO TO 55                               00001146
      IF(NSUB.GE.1) GO TO 60                                             00001147
  600 CAVL=CBAP                                                          00001148
      RETURN                                                             00001149
      END                                                                00001150
```

```
      SUBROUTINE DIESEL(GAL,XMIGAL,XMILE,PLLTNT,IUNIT,NPLTS)                00001151
C-----GAL = TOTAL GALLONS OF DIESEL FUEL CONSUMED;IF USING MILES, GAL MU00001152
C-----BE SET EQUAL TO 0.0-------------------------------------------------00001153
C-----XMIGAL = MILES PER GALLON; CAN OMIT IF USING GALLONS----------------00001154
C-----XMILE = MILES TRAVELED; NEED NOT BE SPECIFIED IF USING GALLONS-----00001155
C-----XPT,XCO,ETC. ARE THE EMISSIONS IN UNITS OF POUNDS OR GRAMS FOR----00001156
C-----PARTICULATES, CARBON MONOXIDE, HYDROCARBONS, ETC.-----------------00001157
C-----IUNIT = 0 MEANS EMISSIONS IN GRAMS ELSE EMISSIONS IN POUNDS-------00001158
      DIMENSION PLLTNT(5)                                                   00001159
      COMMON/FUEL/EF(5),EFG(5)                                              00001160
      COMMON/PCL/NPT,JJ(5)                                                  00001161
C*****************************************************************00001162
C     COMPUTE DIESEL ENGINE POWERED MOTOR VEHICLE EMISSIONS.            00001163
C*****************************************************************00001164
      A=GAL                                                                 00001165
      IF(A.EQ.0.0) A=XMILE/XMIGAL                                           00001166
      CONFCT=1./454.                                                        00001167
      IF(IUNIT.EQ.0) CONFCT=1.0                                             00001168
      DO 10 M=1,NPLTS                                                       00001169
      I=JJ(M)                                                               00001170
   10 PLLTNT(I)=A*EF(I)*CONFCT                                              00001171
      RETURN                                                                00001172
      END                                                                   00001173
```

```
      SUBROUTINE CTEUMO (IHOUR,SRVHR,IUNIT,PLLTNT,DSL,GSOLN,NPLTS)      00001174
      DIMENSION CNSMRT(14),SRVHR(14),PLLTAT(5)                          00001175
      DIMENSION A(5)                                                    00001176
      COMMON/POL/EPT,JJ(5)                                              00001177
      COMMON/FUEL/EFD(5),EFG(5)                                         00001178
      DATA CNSMRT/1.8,0.7,1.75,3*1.5,2.0,1.7,2.35,1.75,1.4,2.0,5.0,1.5/ 00001179
C*****************************************************************     00001180
C-----SUBROUTINE CALCULATES HOURLY EMISSIONS IN PASSENGER GATE AREA RESU00001181
C-----FROM DEMANDS PLACED ON GROUND SERVICE VEHICLES------------------- 00001182
C*****************************************************************     00001183
C-----CALCULATE GALLONS OF DIESEL USED BY AIRSTART AND GROUND POWER VEH 00001184
      DO 30 I=1,5                                                       00001185
   30 PLLTNT(I)=0.0                                                     00001186
      GAL=0.75*SRVHR(11)*8.2+0.50*SRVHR(13)*7.1                         00001187
      IF(GAL.EQ.0.0) GO TO 2                                            00001188
      DSL=DSL+GAL                                                       00001189
      CALL DIESEL (GAL,0.0,0.0,0.0,PLLTNT,IUNIT,NPLTS)                  00001190
    2 CONTINUE                                                          00001191
      GAL=0.5*SRVHR(15)*CNSMRT(13)+SRVHR(14)*CNSMRT(14)                 00001192
      DO 10 I=1,12                                                      00001193
   10 GAL=GAL+SRVHR(I)*CNSMRT(I)                                        00001194
      GSOLN=GSOLN+GAL                                                   00001195
      IF(GAL.EQ.0.0) GO TO 12                                           00001196
      CALL GASOLN (10.,6.0,GAL,0.0,A,NPLTS,IUNIT)                       00001197
      DO 20 M=1,NPLTS                                                   00001198
      I=JJ(M)                                                           00001199
   20 PLLTNT(I)=PLLTNT(I)+A(I)                                          00001200
   12 CONTINUE                                                          00001201
      RETURN                                                            00001202
      END                                                               00001203
```

```
      SUBROUTINE GUESS2(FCTN,PGGA,PGGB,PZERO,TOLL,                      00001204
     1 NITMAX,NFLAG1,NFLAG3,NFLAG4)                                     00001205
C                                                                       00001206
C     CCCCC   MODIFIED FOR PZERO .GT.0.    ONLY                       00001207
C                    SEE STATEMENT 16                                   00001208
C                                                                       00001209
C      THIS PROGRAM HAS BEEN TRANSLATED FOR THE     360/50              00001210
C      WITH RELEASE 1-A OF THE MOD-50 TRANSDECK                         00001211
C                                                        JOB            00001212
      DIMENSION PGG(50),ERR(50)                                         00001213
C*****************************************************************    00001214
C     THIS SUBROUTINE FINDS A ZERO OF THE FUNCTION FCTN(X)              00001215
C     FCTN MUST BE DEFINED BY AN EXTERNAL FUNCTION STATEMENT.           00001216
C                  PGGA AND PGGB ARE TWO INITIAL GUESSES                00001217
C                  TOLL = ALLOWABLE DEVIATION FROM ZERO IF NFLAG4=1      00001218
C                       = ALLOWABLE DIFFERENCE BETWEEN LAST TWO PZERO   00001219
C                         VALUES  IF NFLAG4 = -1                        00001220
C                  NITMAX = MAX NO. OF ITERATIONS                       00001221
C                  NFLAG3 = 1 IF WANT PRINT OUT  VIA THE SUBROUTINE     00001222
C                  NFLAG3 = 0 IF NO PRINT OUT DESIRED                   00001223
C                 INITIALLY CODE SETS NFLAG1=0     .     IF            00001224
C     A DIVIDE CHECK  OR EXCESS NO. OF ITERATIONS OCCURS, SETS NFLAG1=1 00001225
C*****************************************************************    00001226
C                                                                       00001227
      DELTP=ABS(PGGA-PGGB)                                              00001228
      NFLAG1=0                                                          00001229
      NIT=2                                                             00001230
      PGG(1)=PGGA                                                       00001231
      PGG(2)=PGGB                                                       00001232
      I=3                                                               00001233
      IA=1                                                              00001234
      IB=2                                                              00001235
      ERRA=FCTN(PGGA)                                                   00001236
      ERR(1)=ERRA                                                       00001237
      IF(NFLAG4) 2,2,4                                                  00001238
    2 GO TO 5                                                           00001239
    4 VALUE=ABS(ERRA)                                                   00001240
      IF(VALUE-TOLL)400,400,5                                           00001241
  400 PZERO=PGG(1)                                                      00001242
      NIT=1                                                             00001243
      ERRB=ERRA                                                         00001244
      GO TO 100                                                         00001245
    5 ERRB=FCTN(PGGB)                                                   00001246
      IF(NFLAG4) 6,6,8                                                  00001247
    6 VAL=PGG(IA)-PGG(IB)                                               00001248
      VALUE=ABS(VAL)                                                    00001249
      GO TO 9                                                           00001250
    8 VALUE = ABS(ERRB)                                                 00001251
    9 IF(VALUE-TOLL) 100,100,10                                         00001252
   10 CONTINUE                                                          00001253
      VALUE=ABS(ERRA-ERRB)                                              00001254
      IF(VALUE-1.E-28) 75,75,15                                         00001255
   15 PGG(I)=PGG(IB) - ERRB*(PGG(IA)-PGG(IB))/(ERRA-ERRB)               00001256
```

```
   16 IF(PGG(I).LE.C.1*PGG(I)=.001*DELTP                                    00001257
   20 ERRA=ERRB                                                             00001258
      ERR(IB)=ERRB                                                          00001259
      PGGB=PGG(I)                                                           00001260
      I=I+1                                                                 00001261
      IA=I-2                                                                00001262
      IB=I-1                                                                00001263
      NIT=NIT+1                                                             00001264
      IF(NIT-NITMAX) 5,5,70                                                 00001265
C                                                                           00001266
   70 PRINT 71,NITMAX                                                       00001267
   71 FORMAT(1H1,45H MAX. NO. ITER. FOR PZERO EXCEEDED,NITMAX =    I5 //)  00001268
      NFLAG1 = 1                                                            00001269
      GO TO 100                                                             00001270
C                                                                           00001271
   75 CONTINUE                                                              00001272
      NFLAG1=1                                                              00001273
      GO TO 100                                                             00001274
C                                                                           00001275
  100 IF(NFLAG2) 80,80,101                                                  00001276
   80 J=I-1                                                                 00001277
      ERR(J)=ERRB                                                           00001278
      PZERO=PGGB                                                            00001279
      GO TO 125                                                             00001280
C                                                                           00001281
  101 PZERO=PGGB                                                            00001282
      J=I-1                                                                 00001283
      ERR(J)=ERRB                                                           00001284
  104 FORMAT ( ///// )                                                      00001285
  105 FORMAT( 22H NO. OF ITERATIONS =       I5     /// )                   00001286
  115 FORMAT( 4X, 4H NIT ,9X, 6H GUESS , 16X, 6H ERROR          // )        00001287
  120 FORMAT(I5,2E20.8)                                                     00001288
  125 RETURN                                                                00001289
      END                                                                   00001290
```

```
      FUNCTION HMIX(JSTAB,MON,NHR,WS)                                   00001291
      DIMENSION HMM(12)                                                 00001292
      DATA HMM/400.,570.,1000.,930.,1120.,1310.,1180.,990.,980.,570.,   00001293
     1680.,480./                                                        00001294
C*****************************************************************    00001295
C    MIXING DEPTH (IN FEET) IS DETERMINED ON THE BASIS OF STABILITY CLASS00001296
C    AND HOLZWORTH TABLE OF MEAN MONTHLY MAX. MIXING DEPTHS.          00001297
C*****************************************************************    00001298
      HFT=3.281*HMM(MON)                                                00001299
      GO TO (10,20,20,30,40),JSTAB                                      00001300
   10 HMIX=1.5*HFT                                                      00001301
      RETURN                                                            00001302
   20 HMIX=HFT                                                          00001303
      RETURN                                                            00001304
   30 HMIX=HFT                                                          00001305
      IF(NHR.GE.7.AND.NHR.LE.11) HMIX=.5*(HFT+328.)                     00001306
      IF(NHR.GE.17.AND.NHR.LE.21) HMIX=.5*(HFT+328.)                    00001307
      IF(WS.GE.13.8) HMIX=HFT                                           00001308
      RETURN                                                            00001309
   40 HMIX=328.                                                         00001310
      RETURN                                                            00001311
      END                                                               00001312
```

```
      SUBROUTINE LINE(XR,YR,ZR,X1,Y1,Z1,X2,Y2,Z2,CONC)                  00001313
      COMMON/LN/DL,XW1,YW1,ZW1,XW2,YW2,ZW2,COEF1,COEF2,VA1,VA2,VD1,VD2, 00001314
     -A,TIME,VA12,VA22,VD12,VD22,WS2,WSC,IAD,SNAN,CSAN,V1,V2,V12,V22,   00001315
     -TAIL,VS,RR,SP                                                     00001316
      COMMON/MET/WS,WD,JSTAB,MLID,TEMP,XL,SUBOY,SUBOZ                   00001317
      COMMON/LN1/IADC                                                   00001318
C*****************************************************************    00001319
C     PREPARE GEOMETRIC AND KINEMATIC PARAMETERS FOR THE FINITE LINE    00001320
C     SOURCE DISPERSION MODEL CAVL.                                     00001321
C*****************************************************************    00001322
      IAD=IADC                                                          00001323
      AL2=(X2-X1)*(X2-X1)+(Y2-Y1)*(Y2-Y1)+(Z2-Z1)*(Z2-Z1)               00001324
      DL=SQRT(AL2)                                                      00001325
      IF(IAD.EQ.0) GO TO 20                                             00001326
      GO TO (1,2),IAD                                                   00001327
C     FOR ARRIVAL, TIME IS COMPUTED.                                    00001328
    1 V1=VA1                                                            00001329
      V2=VA2                                                            00001330
      V12=VA12                                                          00001331
      V22=VA22                                                          00001332
      TYME=2.*DL/(V1+V2)                                                00001333
      GO TO 10                                                          00001334
C     FOR DEPARTURE, DL IS COMPUTED.                                    00001335
    2 V1=VD1                                                            00001336
      V2=VD2                                                            00001337
      V12=VD12                                                          00001338
      V22=VD22                                                          00001339
      DL1=.5*TIME*(V1+V2)                                               00001340
      X2=X1+(X2-X1)*DL1/DL                                              00001341
      Y2=Y1+(Y2-Y1)*DL1/DL                                              00001342
      DL=DL1                                                            00001343
      TYME=TIME                                                         00001344
   10 A=(V2-V1)/TYME                                                    00001345
   20 XW1=0.                                                            00001346
      YW1=0.                                                            00001347
      ZW1=Z1                                                            00001348
      U=1.                                                              00001349
      TAU=1.                                                            00001350
      TWOPI=2.*3.1415927                                                00001351
      SQR=SQRT(TWOPI)                                                   00001352
      COEF1=1./(SQR*U*TAU)                                              00001353
      COEF2=2./(TWOPI*U*TAU)                                            00001354
      XW2=(X2-X1)*CSAN+(Y2-Y1)*SNAN                                     00001355
      YW2=(X1-X2)*SNAN+(Y2-Y1)*CSAN                                     00001356
      ZW2=Z2                                                            00001357
      XRCP=(XR-X1)*CSAN+(YR-Y1)*SNAN                                    00001358
      YRCP=(X1-XR)*SNAN+(YR-Y1)*CSAN                                    00001359
      ZRCP=ZR                                                           00001360
      IF(IAD.EQ.0) GO TO 50                                             00001361
      CSA = -XW2 / DL                                                   00001362
      WSC = 2 * WS * CSA                                                00001363
      EXT = TAIL / DL                                                   00001364
      DX = XW2 * EXT                                                    00001365
```

```
      DY = YW2 * EXT                                                    00001366
      XW2 = XW2 + DX                                                    00001367
      YW2 = YW2 + DY                                                    00001368
      XRCP = XRCP + DX                                                  00001369
      YRCP = YRCP + DY                                                  00001370
      VS = TAIL / TIME                                                  00001371
      VT = V2 + VS                                                      00001372
      SP2 = WS2 + VT * VT + WSC * VT                                    00001373
      SP = SQRT (SP2)                                                   00001374
      W1 = V1 + VS                                                      00001375
      W2 = V2 + VS                                                      00001376
      YY1 = SQRT(WS2 + W1 * (W1 + WSC))                                 00001377
      YY2 = SQRT(WS2 + W2 * (W2 + WSC))                                 00001378
      ARG = (YY2+ W2 + WSC/2.) / (YY1+ W1 + WSC/2.)                     00001379
      G =YY2 -YY1 - WSC/2. * ALOG(ARG)                                  00001380
      RR = A / G                                                        00001381
   50 CONC=CAVL(XRCP,YRCP,ZRCP)                                         00001382
      RETURN                                                            00001383
      END                                                               00001384
```

```
      SUBROUTINE PSEUDO(DS,U,V,TX,TY,TZ,DX,DY,MSTB,HS,NCL)                00001385
      EXTERNAL SIGGX,SIGGZ                                                00001386
      COMMON/STABIL/NSTB,SIGXO,SIGZO                                      00001387
      COMMON/WDUN/WSAVE                                                   00001388
C*****************************************************************       00001389
C     HORIZONTAL AND VERTICAL SOURCE WIDTHS ARE CONVERTED TO PSEUDO       00001390
C     TRANSPORT TIMES.                                                    00001391
C*****************************************************************       00001392
      EPP=.001                                                            00001393
      A=1.                                                                00001394
      B=.5                                                                00001395
      C=.1                                                                00001396
      D=.01                                                               00001397
      NUL=10                                                              00001398
      NP=0                                                                00001399
      N4=1                                                                00001400
      WSAVE=SQRT(U*U+V*V)                                                 00001401
      NSTB=MSTB                                                           00001402
      IF(NCL.GE.2)  GO TO 9                                               00001403
      SIGXO=DS                                                            00001404
      CALL GUESS2(SIGGX,A,B,TX,EPP,NUL,NF1,NP,N4)                         00001405
      TY=TX                                                               00001406
    9 SIGZO=HS                                                            00001407
   10 CALL GUESS2(SIGGZ,C,D,TZ,EPP,NUL,NF1,NP,N4)                         00001408
   40 TX=U*TX                                                             00001409
      TY=V*TY                                                             00001410
      RETURN                                                              00001411
      END                                                                 00001412
```

```
      SUBROUTINE QMOD (YS1,QL)                                          00001413
      COMMON/LN/DL,XW1,YW1,ZW1,XW2,YW2,ZW2,COEF1,COEF2,VA1,VA2,VD1,VD2,  00001414
     -A,TIME,VA12,VA22,VD12,VD22,WS2,WSC,IAD,SNAN,CSAN,V1,V2,V12,V22,   00001415
     -TAIL,VS,BB,SP                                                     00001416
      COMMON/MET/WS,WD,JSTAB,MIXID,TEMP,XL,SUDDY,SUDDZ                  00001417
C*********************************************************************00001418
C  A MOBILE SOURCE EMISSION MODEL ASSUMING CONSTANT ACCELERATION        00001419
C*********************************************************************00001420
      XS1 = YS1 - TAIL                                                  00001421
      IF (XS1 .LE. -TAIL) XS1 = -TAIL + .001                            00001422
C                                                                       00001423
      IF (XS1 .GT. DL) XS1 = DL - .001                                  00001424
C                                                                       00001425
      FXSI = 0.                                                         00001426
      IF (XS1 .GT. (DL-TAIL)) FXSI = XS1 - DL + TAIL                    00001427
C                                                                       00001428
   30 XSIB = XS1 + TAIL                                                 00001429
      IF (XSIB .GT. DL) XSIB = DL                                       00001430
C                                                                       00001431
      XSIA = 0.                                                         00001432
      IF (XS1 .GT. 0) XSIA = XS1                                        00001433
C                                                                       00001434
      RCOTB = V12 + 2.*A*XSIB                                           00001435
      RCOTA = V12 + 2.*A*XSIA                                           00001436
      VA = SQRT(RCOTA) + VS                                             00001437
      VB = SQRT(RCOTB) + VS                                             00001438
      YA = SQRT(WS2 + VA *(VA + WSC))                                   00001439
      YB = SQRT(WS2 + VB *(VB + WSC))                                   00001440
      ARG = (YB + VB + WSC/2.) / (YA + VA + WSC/2.)                     00001441
      QL = YB - YA - WSC/2. * ALOG(ARG)                                 00001442
      QL = BB / TAIL * (FXSI / SP + QL / A)                             00001443
      RETURN                                                            00001444
      END                                                               00001445
```

```
      FUNCTION SIGGX(THOUR)                                              00001446
      COMMON/STABIL/NSTB,SIGXO,SIGZO                                     00001447
      SIGGX=SIGY(NSTB,THOUR)-SIGXO                                       0000144P
      RETURN                                                             00001449
      END                                                                00001450



      FUNCTION SIGGZ(THOUR)                                              00001451
      COMMON/STABIL/NSTB,SIGXO,SIGZO                                     00001452
      SIGGZ=SIGZ(NSTB,THOUR)-SIGZO                                       00001453
      RETURN                                                             00001454
      END                                                                00001455



      FUNCTION SIGY(J,THOUR)                                             00001456
      COMMON/WOUN/WSAVE                                                  00001457
      DIMENSION A(7),B(7)                                                00001458
      DIMENSION C(5),D(5)                                                00001459
      DATA C/155.,100.,68.,50.,24./,   D/.91,.9?,.93,.90,.93/            00001460
      DATA A/2.1511,1.5454,1.0606,.68465,.59366,.59366,.59366/           00001461
      DATA B/.87326,.88261,.89031,.86866,.89138,.89138,.89138/           00001462
      DATA CONV/.000621371/                                              00001463
C*****************************************************************      00001464
C     COMPUTE HORIZONTAL DISPERSION COEFFICIENT.                         00001465
C*****************************************************************      00001466
C     J=1,2,3,4,5 ARE CLASSES A,C,D,E,F                                  00001467
C    XX AND SIGXY ARE IN MILES                                           00001468
      TSEC=THOUR*3600.                                                   00001469
C                                                                        00001470
      SIGY=(A(J)*TSEC**B(J))*CONV*.87                                    00001471
C  WSAVE IS MEAN WIND SPEED UP TO TIME T.                                00001472
       XX=WSAVE*THOUR*1.609                                              00001473
      JJ=MAXO(J-1,1)                                                     00001474
       SIGXY=C(JJ)*(XX**D(JJ))*.000889                                   00001475
C     .000889=(1/1609.)*(6**.2)                                          00001476
       SIGY=AMAX1(SIGY,SIGXY)                                            00001477
C                                                                        00001478
C     DISPERSION COEFFICIENTS BASED ON TURNER WORKBOOK.                  00001479
C     WHERE THE SIGMAS GIVEN IN THE WORKBOOK FOR                         00001480
C     TEN MINUTE SAMPLINGS ARE SCALED TO 1 HOUR                          00001481
C     AVERAGES BY A FACTOR OF 1.43                                       00001482
      RETURN                                                             00001483
      END                                                                00001484
```

```
      FUNCTION SIGZ(J,THOUR)                                            00001485
      COMMON/WOUN/WSAVE                                                 00001486
C     DISPERSION COEF. BASED ON TURNERS WORKBOOK                        00001487
C     J=1,2,3,4,5 ARE CLASSES B,C,D,E,F                                 00001488
C     X AND SIGZ ARE IN MILES                                           00001489
      DIMENSION C(3,5),D(3,5)                                           00001490
      REAL TIME(7),A(7,6),B(7,6)                                        00001491
C                                                                       00001492
      DATA TIME/0.,300.,1000.,3000.,10000.,30000.,172000./              00001493
      DATA A/.17122,.27668,.41219,.51921,.50963,.47639,.52140,          00001494
     1       .11062,.39553,.41219,.57145,.76485,.71936,.88886,          00001495
     2       .01338,.16640,.41219,1.0813,1.9467,2.3901,1.8877,          00001496
     3       .01338,.16640,.41219,2.2830,2.9850,3.8684,6.7452,          00001497
     3       .01338,.16640,.41219,2.3333,5.7990,16.897,20.673,          00001498
     3       .01338,.16640,.41219,5.6801,14.599,64.577,54.149/          00001499
      DATA B/1.2098,1.0572,.92365,.84130,.79689,.76308,.69839,          00001500
     1       1.2864,.99275,.92365,.82449,.72571,.69082,.60486,          00001501
     2       1.5922,1.1195,.92365,.73217,.59047,.51700,.49583,          00001502
     3       1.5922,1.1195,.92365,.63883,.53706,.45686,.33677,          00001503
     4       1.5922,1.1195,.92365,.63646,.46497,.29621,.21517,          00001504
     5       1.5922,1.1195,.92365,.55016,.37541,.16667,.12177/          00001505
      DATA C/110.,110.,110.,60.,60.,60.,33.,33.,40.,21.5,21.5,36.,14.,  00001506
     114.,23.5/                                                         00001507
      DATA D/1.,1.09,1.04,.92,.92,.92,.80,.61,.53,.70,.56,.35,.78,.53,  00001508
     1.30/                                                              00001509
      DATA CONV/.000621371/                                             00001510
C*********************************************************************00001511
C     COMPUTE VERTICAL DISPERSION COEFFICIENT.                          00001512
C*********************************************************************00001513
      TSEC=THOUR*3600.                                                  00001514
      DO 10 N=2,7                                                       00001515
      IF(TSEC.LE.TIME(N))GO TO 20                                       00001516
   10 CONTINUE                                                          00001517
      IF(N.GT.7)  N=7                                                   00001518
C    TIME OF TRAVEL SHOULD BE LESS THAN 172.E03 SEC    APPROX. 2 DAYS   00001519
   20 CONTINUE                                                          00001520
      N=N-1                                                             00001521
      SIGZ=(A(J,N)*TSEC**B(J,N))*CONV                                   00001522
C      TURNER TEST EQUATION                                             00001523
C     SIGZ=(1.17518*TSEC**.72012)*CONV                                  00001524
      XX=WSAVE*THOUR*1.609                                              00001525
      I=1                                                               00001526
      IF(XX.GT.1.) I=2                                                  00001527
      IF(XX.GT.10.) I=3                                                 00001528
      JJ=MAXO(J-1,1)                                                    00001529
      SIGTZ=(C(I,JJ)*XX**D(I,JJ))*.000714                               00001530
C     .000714=(1/1609)*(20/10)**.2, ASSUMING THAT THE VERTICAL DISPER-  00001531
C     SION COEFFICIENT IS INSENSITIVE TO SAMPLING TIMES OVER 20 MIN.    00001532
      SIGZ=AMAX1(SIGZ,SIGTZ)                                            00001533
      RETURN                                                            00001534
      END                                                               00001535
```

```
      FUNCTION TRAN (NS,KSTAB,HEFA,NREFLAG,IBACK)                       00001536
      COMMON/DELTA/DELY,DELZ                                            00001537
      COMMON/LOC/DW,CW                                                  00001538
      COMMON/MET/WS,WD,JSTAB,HMIX1,TEMP,CL,SUDOY,SUDOZ                  00001539
      COMMON/PL1/XS(5),YS(5),STKH(5),WIT1(5)                            00001540
      COMMON/RECPT/HRECPA,HTAERO,ZRECPC                                 00001541
      COMMON/SEUDC/TX,TY,TZ                                             00001542
      COMMON/XTRAN/WSMD,NCALM,SQ2PI                                     00001543
      COMMON/WDUN/WSAVE                                                 00001544
C*****************************************************************     00001545
C     COMPUTE COUPLING COEFFICIENT AT RECEPTOR DUE TO POINT AND AREA    00001546
C     SOURCE.                                                           00001547
C*****************************************************************     00001548
C      IF(KSTAB.GT.0)HAVE PLUME INITIALLY ABOVE LID.                    00001549
      ZS=STKH(NS)/5280.                                                 00001550
      HEFF=HEFA/528C.                                                   00001551
      WIT=WIT1(NS)                                                      00001552
      JSTABT=JSTAB                                                      00001553
      WSAVE=WSMD                                                        00001554
      HRECPT=HRECPA/5280.                                               00001555
      ZKEEP=HRECPT                                                      00001556
      ADD1=0.                                                           00001557
      ADD2=0.                                                           00001558
      ADD3=0.                                                           00001559
      ADD4=C.                                                           00001560
      ADD5=0.                                                           00001561
      ADD6=C.                                                           00001562
      WJWG = 0.                                                         00001563
      XL = CL                                                           00001564
C                                                                       00001565
      IF(KSTAB.GT.0)GO TO 121                                           00001566
      HLID=HMIX1/5280.                                                  00001567
      GOTO 140                                                          00001568
  121 JSTABT=4                                                          00001569
      IF(KSTAB.EQ.2) GOTO130                                            00001570
      JSTABT=5                                                          00001571
  130  CONTINUE                                                         00001572
      HLID=1000./5280.                                                  00001573
      XL=30./5280.                                                      00001574
  140 CONTINUE                                                          00001575
C      IF PLUME BELOW LID AND RECEPTOR ABOVE, TRAN=0.                   00001576
      IF(HRECPT.GT.HLID.AND.KSTAB.EQ.0)GOTO76                           00001577
      IF(WSAVE .LE. WJWG) GO TO 9596                                    00001578
      DMIN=ABS(CW)                                                      00001579
      TMIN=DW/WSAVE                                                     00001580
  305 CONTINUE                                                          00001581
      TT=TMIN+TY                                                        00001582
      IF(TT.LE.C.)GOTO 76                                               00001583
      IF(NREFLAG.NE.0) GO TO 143                                        00001584
      TMIN = 0.                                                         00001585
      IF (DW .GE. WIT) TMIN = (DW   - WIT) / WSAVE                      00001586
      IF(IBACK.EQ.0) GO TO 131                                          00001587
      IF(DW+WIT-DELY) 132,132,133                                       00001588
```

```
 132 TMIN=0.                                                                    00001589
     GO TO 131                                                                  00001590
 133 TMIN=(DW+WIT-DELY)/WSAVE                                                   00001591
 131 TT = TMIN + TY                                                             00001592
     IF(TT.LE..01)TT=.01                                                        00001593
     SY=SIGY(JSTART,TT)                                                         00001594
     XRR = WIT + DW                                                             00001595
     IF (XRR .GE. 2.*WIT) GO TO 142                                             00001596
     DW = XRR / 2.                                                              00001597
 142 TTT = TZ + DW / WSAVE                                                      00001598
     SZ=SIGZ(JSTART,TTT)                                                        00001599
     RD=DMIN/SY                                                                 00001600
     EXPL=-.5*RD*RD                                                             00001601
     IF(EXPL.LT.-20.)GOTO 76                                                    00001602
     RDD=EXP(EXPL)                                                              00001603
     IF(DW.GT.2.*XL)GOTO 153                                                    00001604
     DENOM=6.2831853*WSAVE*SY*SZ                                                00001605
     Z1 =  HEFF-ZKEEP                                                           00001606
     EXPZ1=(-.5*(Z1/SZ)*(Z1/SZ))                                                00001607
     IF(EXPZ1.LT.-20.)GOTO 76                                                   00001608
     E1=EXP(EXPZ1)                                                              00001609
     ADD1=E1*RDD/DENOM                                                          00001610
     IF (HEFF.GT.0.0) GO TO 171                                                 00001611
     ADD2=ADD1                                                                  00001612
     GOTO 172                                                                   00001613
 171 CONTINUE                                                                   00001614
     Z2 = HEFF + ZKEEP                                                          00001615
     EXPZ2=(-.5*(Z2/SZ)*(Z2/SZ))                                                00001616
     IF(EXPZ2.LT.-20.)GOTO 61                                                   00001617
     E2=EXP(EXPZ2)                                                              00001618
     ADD2=ADD1*E2/E1                                                            00001619
 172 CONTINUE                                                                   00001620
     IF(HEFF.GT.HLID/2..OR.SZ.GE.(HLID-HEFF)/2.2) GO TO 18                      00001621
     GO TO 61                                                                   00001622
 18      CONTINUE                                                               00001623
     IF(HEFF.LT.HLID) GO TO 174                                                 00001624
     ADD3=ADD1                                                                  00001625
     ADD4=ADD2                                                                  00001626
     GOTO 173                                                                   00001627
 174 CONTINUE                                                                   00001628
     Z3= (2.*HLID-HEFF)-ZKEEP                                                   00001629
     EXPZ3=(-.5*(Z3/SZ)*(Z3/SZ))                                                00001630
     IF(EXPZ3.LT.-20.)GOTO 61                                                   00001631
     E3=EXP(EXPZ3)                                                              00001632
     ADD3=ADD1*E3/E1                                                            00001633
     Z4= Z3+2.*ZKEEP                                                            00001634
     EXPZ4=-.5*(Z4/SZ)*(Z4/SZ)                                                  00001635
     IF(EXPZ4.LT.-20.)GOTO 61                                                   00001636
     E4=EXP(EXPZ4)                                                              00001637
     ADD4=ADD1*E4/E1                                                            00001638
     IF (HEFF.GT.0.0) GO TO 173                                                 00001639
     ADD3=ADD3                                                                  00001640
     ADD4=ADD4                                                                  00001641
     GO TO 61                                                                   00001642
 173 CONTINUE                                                                   00001643
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```
      Z5=Z2+2.*(HLID-ZKEEP)                                          00001644
      EXPZ5=-.5*(Z5/SZ)*(Z5/SZ)                                      00001645
      IF(EXPZ5.LT.-20.)GOTO 61                                       00001646
      E5=EXP(EXPZ5)                                                  00001647
      ADD5=ADD1*E5/E1                                                00001648
      Z6=Z5+2.*ZKEEP                                                 00001649
      EXPZ6=-.5*(Z6/SZ)*(Z6/SZ)                                      00001650
      IF(EXPZ6.LT.-20.)GOTO 61                                       00001651
      E6=EXP(EXPZ6)                                                  00001652
      ADD6=ADD1*E6/E1                                                00001653
      GO TO 61                                                       00001654
  153 DENOM=SQ2PI*WSAVE*SY                                           00001655
      ADD1=EDD/(DENOM*HLID)                                          00001656
   61 CONTINUE                                                       00001657
      TRAN=ADD1+ADD2+ADD3+ADD4+ADD5+ADD6                             00001658
      RETURN                                                         00001659
  143 IF(IMACK.EQ.1) GO TO 144                                       00001660
      T2=(DW+WIT)/ WSAVE+TZ                                          00001661
      IF(DW-WIT) 145,145,146                                         00001662
  145 T1=TZ                                                          00001663
      TT=TY                                                          00001664
      GO TO 149                                                      00001665
  146 T1=(DW-WIT)/ WSAVE+TZ                                          00001666
      TT=(DW-WIT)/ WSAVE+TY                                          00001667
      GO TO 149                                                      00001668
  144 T2=XL/ WSAVE+TZ                                                00001669
      IF(DW+WIT-DELY) 147,147,148                                    00001670
  147 T1=TZ                                                          00001671
      TT=TY                                                          00001672
      GO TO 149                                                      00001673
  148 T1=(DW+WIT-DELY)/ WSAVE+TZ                                     00001674
      TT=(DW+WIT-DELY)/ WSAVE+TY                                     00001675
  149 IF(T1.EQ.TZ) GO TO 150                                         00001676
      SZ1=SIGZ(JSTABT,T1)                                            00001677
      GO TO 151                                                      00001678
  150 SZ1= DELZ/2.4                                                  00001679
  151 SZ2=SIGZ(JSTABT,T2)                                            00001680
      IF(TT.EQ.TY) GO TO 152                                         00001681
      SY=SIGY(JSTABT,TT)                                             00001682
      GO TO 155                                                      00001683
  152 SY=DELY/2.4                                                    00001684
  155 ARGY=-(DW/SY)**2/2.                                            00001685
      IF(ARGY.LT.-20.) GO TO 76                                      00001686
      H=ALOG(SZ1/SZ2)/ALOG(T1/T2)                                    00001687
  159 EXZ1=0.                                                        00001688
      EXZ2=0.                                                        00001689
      AGZ1=-((ZS-HREFCPT)/SZ2)**2/2.                                 00001690
      AGZ2=-((ZS+HREFCPT)/SZ2)**2/2.                                 00001691
      IF(AGZ1.LT.-20) GO TO 157                                      00001692
      EXZ1=EXP(AGZ1)                                                 00001693
  157 IF(AGZ2.LT.-20) GO TO 158                                      00001694
      EXZ2=EXP(AGZ2)                                                 00001695
  158 CONTINUE                                                       00001696
      IF((EXZ1+EXZ2).LE.0.) GO TO 76                                 00001697
      EXY=EXP(ARGY)                                                  00001698
```

```
      IF(ABS(B-1.).LE..01) GO TO 2                                    00001699
      FCNX=(T2/SZ2-T1/SZ1)/(1.-B)                                     00001700
      GO TO 3                                                         00001701
    2 FCNX=T1*ALOG(T2/T1)/SZ1                                         00001702
    3 TRAN=EXY*(EXZ1+EXZ2)*FCNX/((SQ2PI**2)*SY*DELY)                  00001703
      IBACK=0                                                         00001704
      RETURN                                                          00001705
   76 TRAN=0.                                                         00001706
      IBACK=0                                                         00001707
      RETURN                                                          00001708
 2596  CONTINUE                                                       00001709
      IBACK=0                                                         00001710
      RETURN                                                          00001711
      END                                                             00001712
```